DATA TRANSLATION

UM-22967-E

DT8871U and DT8871

TEMPpoint

Temperature Instruments for LXI User's Manual

Fifth Edition
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Radio and Television Interference

This equipment has been tested and found to comply with CISPR EN55022 Class A and EN61000-6-1 requirements and also with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

Changes or modifications to this equipment not expressly approved by Data Translation could void your authority to operate the equipment under Part 15 of the FCC Rules.

Note: This product was verified to meet FCC requirements under test conditions that included use of shielded cables and connectors between system components. It is important that you use shielded cables and connectors to reduce the possibility of causing interference to radio, television, and other electronic devices.

Canadian Department of Communications Statement

This digital apparatus does not exceed the Class A limits for radio noise emissions from digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications.

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de la class A prescrites dans le Règlement sur le brouillage radioélectrique édicté par le Ministère des Communications du Canada.

Table of Contents

About this Manual

TEMPpoint is a family of temperature measurement instruments that includes the DT9871U, DT9871, DT8871U, DT8871, DT9872, and DT8872. The DT8871U and DT8871 are Ethernet, LXI (LAN eXtensions for Instrumentation) instruments, capable of measuring thermocouples and/or voltage inputs.

The first part of this manual describes how to install and set up your DT8871U or DT8871 temperature instrument, and verify that the instrument is working properly.

The second part of this manual describes the features and capabilities of your instrument using the IVI-COM instrument driver software. Troubleshooting information is also provided.

Note: If you are using programming the instrument using the IVI-COM driver, refer to the DtxTEMPpoint IVI-COM driver online help for more information.

If you are using the Measure Foundry to program your instrument, refer to the *Measure Foundry User's Manual* and online help for more information.

If you are using Standard Commands for Programmable Instruments (SCPI) to program your instrument, refer to the *SCPI Programmer's Manual for TEMPpoint* for more information.

Intended Audience

This document is intended for engineers, scientists, technicians, or others responsible for using and/or programming the DT8871U or DT8871 temperature instrument. It is assumed that you have some familiarity with thermocouples and that you understand your application.

How this Manual is Organized

This manual is organized as follows:

- Chapter 1, "Overview," summarizes the major features of the DT8871U and DT8871 temperature instruments, as well as the supported software and accessories.
- Chapter 2, "Preparing to Use the DT8871U or DT8871," describes how to unpack the instrument, check the system requirements, install the TEMPpoint software, and view the TEMPpoint documentation online.
- Chapter 3, "Setting Up and Installing the DT8871U or DT8871," describes how to apply power to the DT8871U or DT8871 and connect the instrument to the network.
- Chapter 4, "Wiring Signals," describes how to wire signals to the DT8871U and DT8871 instruments.
- Chapter 5, "Verifying the Operation of the DT8871U or DT8871," describes how to verify the operation of the DT8871U and DT8871 instruments with the instrument's web interface.
- Chapter 6, "Principles of Operation," describes all of the features of the DT8871U and DT8871 instruments in detail.
- Chapter 7, "Troubleshooting," provides information that you can use to resolve problems with the DT8871U and DT8871 temperature instruments, should they occur.

- Appendix A, "Specifications," lists the specifications of the DT8871U and DT8871.
- Appendix B, "Connector Pin Assignments," describes the pin assignments of the digital I/O connector on the DT8871U and DT8871 temperature instruments.
- Appendix C, "Using the TEMPpoint Application," describes how to use the TEMPpoint application with the DT8871U and DT8871.
- Appendix D, "Configuring Network Settings on Your PC," describes how to configure the network settings of your PC to use Auto-IP or a static IP address.
- An index completes this manual.

Conventions Used in this Manual

The following conventions are used in this manual:

- Notes provide useful information or information that requires special emphasis, cautions provide information to help you avoid losing data or damaging your equipment, and warnings provide information to help you avoid catastrophic damage to yourself or your equipment.
- Items that you select or type are shown in **bold**.

Related Information

Refer to the following documents for more information on using the DT8871U and DT8871 temperature instruments:

- DtxTEMPpoint IVI-COM Driver online help. For programmers who are developing their own application programs using a tool other than Measure Foundry, this document describes how to use the IVI-COM driver to access the capabilities of the TEMPpoint instrument.

The TEMPpoint IVI-COM driver works with any development environment that supports COM programming, including MATLAB® from The MathWorks™, Microsoft® Visual C#®.NET or Visual Basic®.NET, Agilent® VEE Pro, National Instruments™ LabVIEW™ or LabWindows™, and so on.

- Measure Foundry manual and online help. For programmers who purchase Measure Foundry to easily create custom applications for TEMPpoint, these documents describe the functions and capabilities of the Measure Foundry software.
- *SCPI Programmer's Manual for TEMPpoint*. For programmers who want to use the SCPI interface to program TEMPpoint instruments, this document describes the supported SCPI commands and example programs for TEMPpoint.
- IVI foundation (www.ivifoundation.org)
- *Omega Complete Temperature Measurement Handbook and Encyclopedia*® or the Omega Engineering web site: http://www.omega.com. Both resources provide valuable information on thermocouple types, standards, and linearization.

Where To Get Help

Should you run into problems installing or using the DT8871U or DT8871 temperature instrument, the Data Translation Technical Support Department is available to provide technical assistance. Refer to Chapter 7 for more information. If you are outside the United States or Canada, call your local distributor, whose number is listed on our web site (www.datatranslation.com).

Overview

Hardware Features

TEMPpoint is a family of temperature measurement instruments that includes the DT8871U and DT8871. The DT8871U and DT8871 are 24-bit temperature instruments for the Ethernet (LXI) bus. It is a class C device and complies with LXI version 1.1. The DT8871U and DT8871 instruments are available in a number of configurations, listed in Table 1, to accommodate the number of analog input channels you need. The DT8871U version is an ultra-quiet version of the DT8871; the DT8871 offers the same features as the DT8871U, but has different A/D noise and input range specifications.

Table 1: DT8871U and DT8871 Models

Models	Number of Analog Input Channels	A/D Noise[a]	A/D Input Range
DT8871U-8	8	0.25 µV RMS	±0.075 V
DT8871U-16	16		
DT8871U-24	24		
DT8871U-32	32		
DT8871U-40	40		
DT8871U-48	48		
DT8871-8	8	5 µV RMS	±1.25 V
DT8871-16	16		
DT8871-24	24		
DT8871-32	32		
DT8871-40	40		
DT8871-48	48		

a. The A/D noise specification is based on the raw (none) software filter.

The key hardware features of the DT8871U and DT8871 temperature instruments are as follows:

- Analog input subsystem:
  - Configurable analog input channels for thermocouple or differential voltage inputs; easy-access jacks for each channel for quick wiring
  - One CJC (cold junction compensation) input for each thermocouple channel
  - One 24-bit, Delta-Sigma A/D converter per channel for simultaneous, high-resolution measurements
  - B, E, J, K, N, R, S, and T thermocouple types supported; the instrument automatically linearizes the measurements and returns the data as a 32-bit, floating-point temperature values
  - ±500 V galvanic isolation channel-to-channel and to the host computer to protect signal integrity.
  - +100 nA break-detection circuitry to detect open thermocouple inputs.
  - Throughput rate of up to 10 Samples/s for all channels.
  - Auto-calibrating front-end resets the zero point on each power-up; in addition, the instrument supports anytime calibration, performing an auto-calibration function on software command
  - A TEMPpoint Calibration Utility is available for calibrating your TEMPpoint instrument in the field (see page 20 for more information on this utility)
- Digital I/O subsystem:
  - 8 opto-isolated digital input lines
  - 8 opto-isolated digital output lines; the outputs are solid-state relays that operate from ±30 V at currents up to 400 mA (peak) AC or DC

- Digital I/O galvanically isolated to 250 V when using all digital input lines
- You can read the digital input port through the analog input data stream for correlating analog and digital measurements

Supported Software

The following software is available for use with the DT8871U and DT8871 temperature instruments:

- **Eureka Discovery Utility** – This utility helps you locate or "discover" all LXI (Ethernet) instruments that are connected to your system and provides the following information about your instrument: the IP address, manufacturer, model number, serial number, and version of the firmware that is running on your instrument. In addition, you can use this utility to configure Windows firewall settings and update the firmware for your Data Translation LXI instrument.
- **Instrument Web Interface** – This built-in interface, described in Chapter 5, allows you to verify the operation of your TEMPpoint instrument and perform basic functions with Internet Explorer and no additional software. Using it, you can configure your instrument, control output signals, measure input signals, and save results to disk.
- **TEMPpoint application** – This application, developed using Measure Foundry, lets you do the following:
  - Configure your TEMPpoint instrument
  - Acquire temperature and voltage data from up to 48 analog input channels
  - Display acquired temperature and voltage data during acquisition
  - Set alarm limits for each channel
  - Update the value of the digital output lines based on alarm conditions
  - Use a chart recorder to display data over time and log it to an .hpf file for later analysis
  - Open the last recorded .hpf data file in Microsoft Excel
  - View any .hpf data file in a file viewer

You can customize this application to suit your needs using Measure Foundry Professional with the Instrument Pak; the source code for this application is included with TEMPpoint.

- **Measure Foundry –** An evaluation version of this software is available for developing applications for TEMPpoint instruments. Measure Foundry is a rapid application development package that provides a system solution for all types of measurement instruments. Using Measure Foundry, you can develop complex test and measurement applications easily without writing code. Simply drag and drop components on a form and configure their property pages to access all elements of your system.

  Measure Foundry supports all LXI instrument classes through IVI-COM. Instruments with interfaces such as GPIB, PXI/LXI, RS-232, and USB are supported through SCPI commands using the VISA transport layer.

  Order the Instrument Pak for Measure Foundry (SP1309-CD) to build your own application for the TEMPpoint instrument.

- **DtxTEMPpoint IVI-COM driver** – This driver provides access to the DT8871U or DT8871 temperature instrument functions through a COM server. The IVI-COM driver works in any development environment that supports COM programming, including Measure Foundry, MATLAB, Visual Basic.NET, Visual C#.NET, Agilent VEE Pro, LabVIEW, LabWindows, and others.

- **SCPI commands** – Use SCPI commands to program TEMPpoint LXI instruments. Refer to the *SCPI Programmer's Manual for TEMPpoint* (UM-23040) for information on the supported SCPI commands and example programs.

- **TEMPpoint Calibration Utility** – Users can calibrate any TEMPpoint instrument in the field using precise calibration equipment and the TEMPpoint Calibration Utility. Since each TEMPpoint instrument consists of 48 individual instruments, great care must be taken to ensure that proper warm-up times are followed and precise calibration equipment is used.

The TEMPpoint Calibration Utility ships with a comprehensive help file that describes the required equipment and calibration procedure, including warm-up times, for each TEMPpoint model.

The TEMPpoint Calibration Utility allows you to revert to the factory calibration for any or all channels, or revert back to the last user calibration values, if desired. In addition, this utility generates a report that lists the starting and ending calibration values for each channel, allowing traceability.

Refer to the Data Translation web site (www.datatranslation.com) for information about selecting the right software package for your needs.

Accessories

The following optional accessories are available for the DT8871U and DT8871 instruments:

- **STP37 screw terminal panel** – The STP37 permits easy screw terminal connections for accessing the digital I/O signals of the TEMPpoint instrument.
- **EP333 cable** – The EP333 is a 2-meter shielded cable with two 37-pin connectors that connects the STP37 screw terminal panel to the digital I/O connector of the TEMPpoint instrument.
- **Rack-mount kits** – To rack mount a single TEMPpoint instrument, order a single rack-mount kit (Data Translation part number 22927).

  To rack mount two TEMPpoint instruments side by side, order a dual rack-mount kit (Data Translation part number 22735).

Getting Started Procedure

The flow diagram shown in Figure 1 illustrates the steps needed to get started using the DT8871U or DT8871 temperature instrument. This diagram is repeated in each Getting Started chapter; the shaded area in the diagram shows you where you are in the getting started procedure.

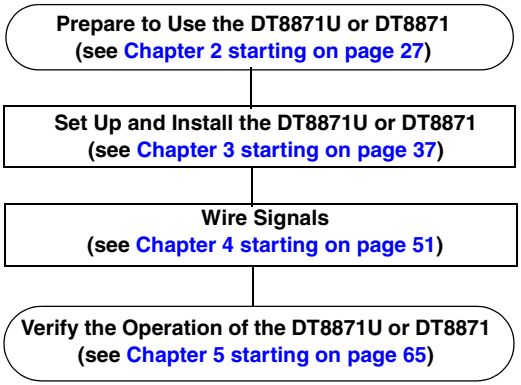
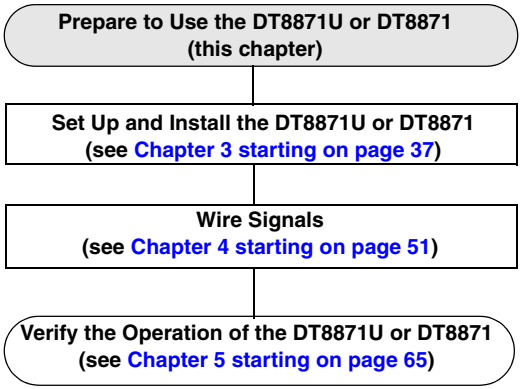


Figure 1: Getting Started Flow Diagram

Part 1: Getting Started

Preparing to Use the DT8871U or DT8871


Prepare to Use the DT8871U or DT8871
(this chapter)
Set Up and Install the DT8871U or DT8871
(see Chapter 3 starting on page 37)
Wire Signals
(see Chapter 4 starting on page 51)
Verify the Operation of the DT8871U or DT8871
(see Chapter 5 starting on page 65)

Unpacking

Open the shipping box and verify that the following items are present:

- DT8871U or DT8871 temperature instrument
- EP372 Ethernet cable
- EP361 +5V power supply and cable
- TEMPpoint CD-ROM

If an item is missing or damaged, contact Data Translation. If you are in the United States, call the Customer Service Department at (508) 481-3700, ext. 1323. An application engineer will guide you through the appropriate steps for replacing missing or damaged items. If you are located outside the United States, call your local distributor, listed on Data Translation's web site (www.datatranslation.com).

Once you have unpacked your DT8871U or DT8871 temperature instrument, check the system requirements, as described in the next section.

Checking the System Requirements

For reliable operation, the computer that accesses your DT8872 temperature instrument requires the following configuration:

- PC with Pentium III, 500 MHz (or higher) processor
- Screen resolution of 1024 x 768 (or higher)
- 256 MB of RAM; 512 MB (or more) recommended
- 50 MB of hard disk space
- Ethernet port
- CD-ROM drive
- Administrator privileges for software installation
- For access to the instrument web interface:
  - Java Version 6, Update 5 or greater
  - Internet Explorer 6.0 or 7.0 web browser

  Refer to page 67 for more information on installing Java and configuring your browser settings
- Acrobat Reader 5.0 or later for viewing documentation

Once you have verified that your system meets the system requirements, install the software, as described in the next section.

Installing the Software

This section describes how to install the software you need to use the DT8871U or DT8871 TEMPpoint instrument.

Prerequisite Software

No prerequisite software is required if you are using a single client to access the TEMPpoint instrument on the LXI bus, or if you are managing how multiple clients concurrently access a TEMPpoint instrument on the LXI bus. (In these case, your application can use sockets to communicate with the TEMPpoint instrument.)

If, however, you want multiple clients to access the TEMPpoint instrument on the LXI bus, and you want to "lock" access to the instrument so that one client cannot change the configuration of the instrument that another client is accessing, you need to install VISA; we recommend either Agilent VISA or NI-VISA from National Instruments. You can then use the VISA methods viLock/viUnlock to prevent other clients from accessing the instrument.

To install Agilent VISA, do the following:

1. Go to **www.agilent.com**, enter **IO Libraries Suite** in the search field, and select **Agilent IO Libraries Suite 15.0** from the search results.
2. Follow the instructions on Agilent's web site to download and install the Agilent IO Libraries, which include VISA support, VISA COM support, and the Agilent Connection Expert tool.

We recommend that you run Data Translation's Eureka Discovery Utility that is provided with the TEMPpoint software to locate your TEMPpoint LXI instrument on the network (see page 75 for more information).

Installing the IVI-COM Driver, TEMPpoint Application, and Eureka Discovery Utility

The TEMPpoint application, developed using Measure Foundry, provides a quick way to verify that your temperature measurement instrument is working properly. To install the TEMPpoint application, the Eureka Discovery Utility, and all the components necessary to use the TEMPpoint application with the DT8871U or DT8871 instrument, including the IVI-COM driver, perform the following steps:

1. Insert the TEMPpoint CD into your CD-ROM or DVD drive.
   The installation program should automatically start, and the TEMPpoint installation program should appear.
2. If the installation program does not automatically start, double-click **Setup.exe** from the CD.
   The TEMPpoint installation program appears.
3. Click **Install from Web (recommended)** to get the latest version of the software or **Install from CD** to install the software from the CD.
4. If you are installing from the web, perform these steps:
   a. Click **TEMPpoint Software** and follow the prompts to install the TEMPpoint software (including the TEMPpoint application and IVI-COM driver) and related documentation.
   b. If you wish to install the evaluation version of Measure Foundry, click **Measure Foundry (Evaluation)** from the TEMPpoint Installation web site, and follow the prompts to install the software and related documentation.

      Note: To use Measure Foundry with the TEMPpoint instruments, select the evaluation version of **Measure Foundry Pro + Instruments Pak**.

c. If you wish to install the Eureka Discovery Utility (recommended), click **Eureka Discovery Utility** from the TEMPpoint Installation web site, and follow the prompts to install the software and help file.

5. If you are installing from the TEMPpoint CD, perform these steps:

a. Click **Install TEMPpoint**.

b. Ensure that **TEMPpoint (Software & Application)** is selected.

c. If you wish to install the evaluation version of Measure Foundry in addition to the TEMPpoint application, also select **Measure Foundry (EVAL)**.

Note: To use Measure Foundry with the TEMPpoint instruments, select the evaluation version of **Measure Foundry Pro + Instruments Pak**.

d. If you wish to install the Eureka Discovery Utility (recommended), select **Eureka Discovery Utility**.

e. Click **Install Selected Features** and follow the prompts to install the software.

f. When you are finished with the TEMPpoint CD, click **Quit Installer**.

For information on using the TEMPpoint application to verify the operation of the DT8871U or DT8871 instrument, refer to Chapter 5 starting on page 65.

Installing SCPI Support Software

Note: The DT8871U, DT8871, and DT8872 TEMPpoint instruments do not support DT-Open Layers programming. Do not select the USB-only packages.

If you wish, you can develop application programs for the DT8871U and DT8871 TEMPpoint instruments using SCPI (Standard Commands for Programmable Instruments). To install the SCPI example programs and documentation, perform the following steps:

1. If you have not already done so, perform the following steps:
   a. Insert the TEMPpoint CD into your CD-ROM or DVD drive. *The installation program should automatically start, and the TEMPpoint installation program should appear.*
   b. If the installation program does not automatically start, double-click **Setup.exe** from the CD. *The TEMPpoint installation program appears.*
   c. Click **Install from Web** or **Install from CD**.
2. If you are installing from the web, click **TEMPpoint SCPI Support** and follow the prompts to install the example programs and documentation.
3. If you are installing from the TEMPpoint CD, perform these steps:
   a. Click **Install Additional Software**.
   b. Click **TEMPpoint SCPI Support**.
   c. Click **Install Selected Features** and follow the prompts to install the example programs and documentation.
   d. When you are finished with the TEMPpoint CD, click **Quit Installer**.

Viewing the Documentation

Note: To view the documentation, you must have Adobe Reader 5.0 or greater installed on your system. Adobe Reader is provided on the TEMPpoint CD. If you install Adobe Reader from this CD, make sure that you open Adobe Reader and accept the license agreement before viewing the documentation.

You can access the documentation for your TEMPpoint instrument from the Windows Start menu as follows:

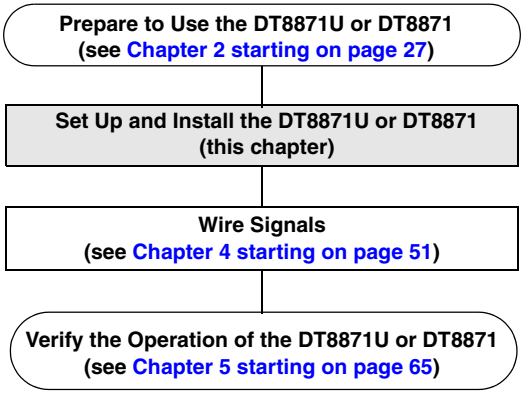
- For documentation about the DT8871U and DT8871, click **Programs -> Data Translation, Inc -> Hardware Documentation -> DT8871 User's Manual**.
- For documentation on the DtxTempPoint IVI-COM driver, click **Programs -> IVI -> DtxTempPoint -> Documentation**.
- For documentation on the Eureka Discovery Utility, click **Programs -> Data Translation, Inc -> Instrument Support -> Eureka LXI Instrument Discovery**.
- For documentation about SCPI support for TEMPpoint, click **Programs -> Data Translation, Inc -> TEMPpoint SCPI Support**.
- For documentation about Measure Foundry, click **Programs -> Data Translation, Inc -> Measure Foundry -> 5.1**.

The following may be helpful when using Adobe Reader:

- To navigate to a specific section of the document, click a heading from the table of contents on the left side of the document.
- Within the document, click the text shown in blue to jump to the appropriate reference (the pointer changes from a hand to an index finger).

- To go back to the page from which the jump was made, click the right mouse button and **Go Back,** or from the main menu, click **Document**, and then **Go Back.**
- To increase or decrease the size of the displayed document, from the main menu, click **View**, and then **Zoom**.
- By default, Adobe Reader smooths text and monochrome images, sometimes resulting in blurry images. If you wish, you can turn smoothing off by clicking **File**, and then **Preferences/General**, and unchecking **Smooth Text and Images**.

Setting Up and Installing the DT8871U or DT8871



Note: Your DT8871U and DT8871 temperature instruments are factory-calibrated. Thereafter, yearly recalibration is recommended. Refer to page 107 for more information on calibration.

Connecting the DT8871U or DT8871 to the LAN

This section describes how to connect the DT8871U or DT8871 temperature instrument to the LAN (Local Area Network). Two connection schemes are shown:

- Site LAN connections, described on this page
- Private LAN connections, described on page 41

Note: It is recommended that you consult with your network administrator to ensure that all network security, performance, and reliability issues are considered when using connecting TEMPpoint instruments to the LAN.

Connecting to a Site LAN

A site LAN is useful in applications that require access by many users or access by users at distributed sites. In this connection scheme, a DHCP (Dynamic Host Configuration Protocol) server is used to assign an IP address to the TEMPpoint instrument.

Figure 2 shows a typical site LAN connections using a dedicated Ethernet hub, switch, or router. Figure 3 shows typical site LAN connections without using a dedicated Ethernet hub, switch, or router.

Note: Use standard LAN cables for network connections. The TEMPpoint instrument ships with a standard LAN cable (EP372) for connecting to the LAN (RJ45) connector on the rear panel of the TEMPpoint instrument.

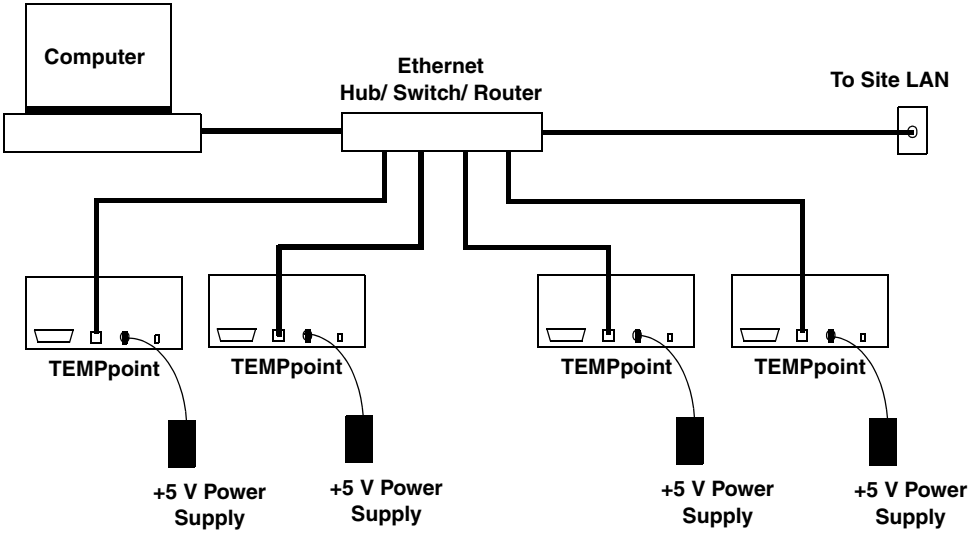


Figure 2: Typical Site LAN Connections using a Hub, Switch, or Router

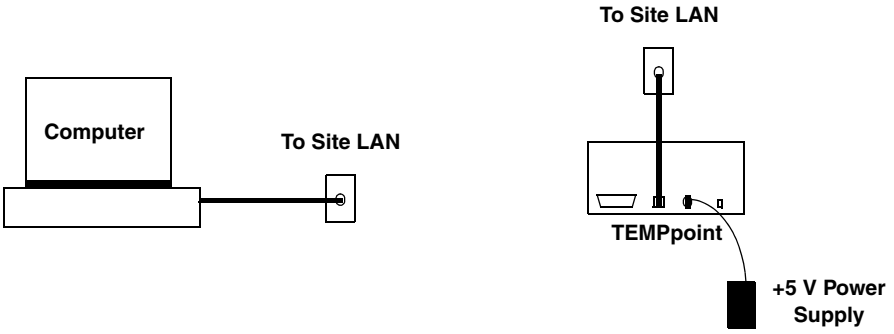


Figure 3: Typical Site LAN Connections Without Using a Hub, Switch, or Router

Connecting to a Private LAN

A private LAN (or subnet) generally involves the direct connection of the instruments to the computer, and may include Ethernet hubs or switches. Access to the instruments is limited to users that are directly connected to the private LAN; therefore, security, performance, and reliably are generally better on a private LAN than on a site LAN.

In this connection scheme, the DHCP (Dynamic Host Configuration Protocol) server is typically not available; therefore, Auto-IP is used to assign an IP address to the TEMPpoint instrument.

Note: If no DHCP server exists and your PC is set up to use a static IP address, you must temporarily reconfigure your PC to use Auto-IP, as described on Appendix D starting on page 167.

Connecting Using a Hub or Switch

Figure 4 shows a typical connection scheme when connecting TEMPpoint instruments to a private LAN using a dedicated Ethernet hub or switch.

Note: Use standard LAN cables for network connections. The TEMPpoint instrument ships with a standard LAN cable (EP372) for connecting to the LAN (RJ45) connector on the rear panel of the TEMPpoint instrument.

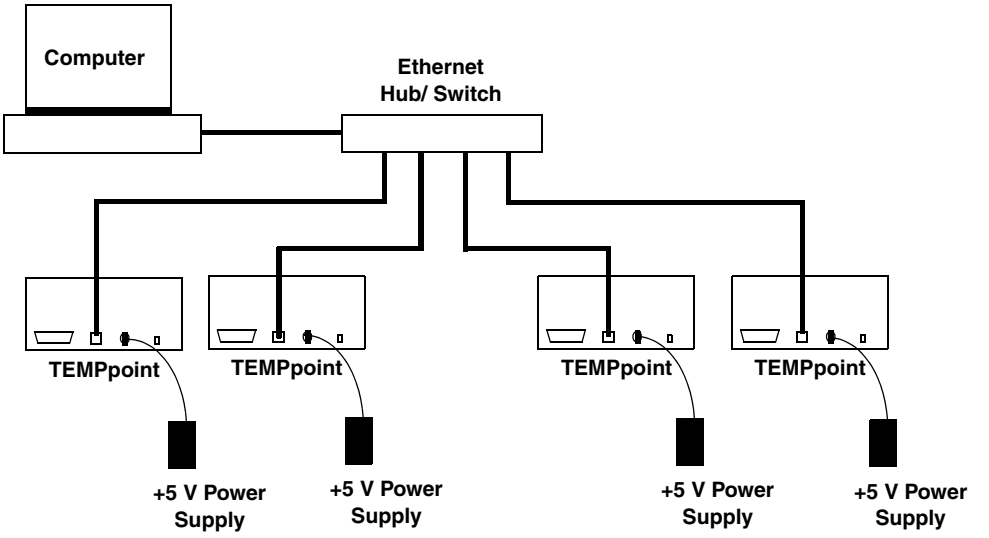


Figure 4: Typical Private LAN Connections using a Hub or Switch

Connecting Directly to a Computer

Optionally, you can connect the TEMPpoint instrument directly to your computer, creating an ad hoc network, as shown in Figure 5. Be aware that the time and date settings of the instrument will not be updated using this connection method. Therefore, this connection scheme is generally recommended for quick set up and verification only.

Note: TEMPpoint instruments do not support the Auto-MDIX function; therefore, use a crossover cable rather than a standard LAN cable to connect your TEMPpoint instrument unless your computer has enabled the Auto-MDIX function.

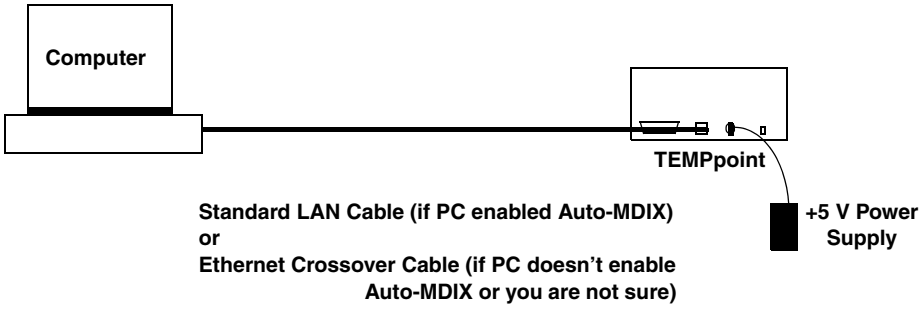


Figure 5: Typical Private LAN Connections when Connecting Directly to a Computer

Applying Power

The DT8871U and DT8871 temperature instruments are shipped with an EP361 +5V power supply and cable. To apply power to the instrument, do the following:

1. Connect the +5 V power supply to the power connector on the rear panel of the DT8871U or DT8871. Refer to Figure 6.

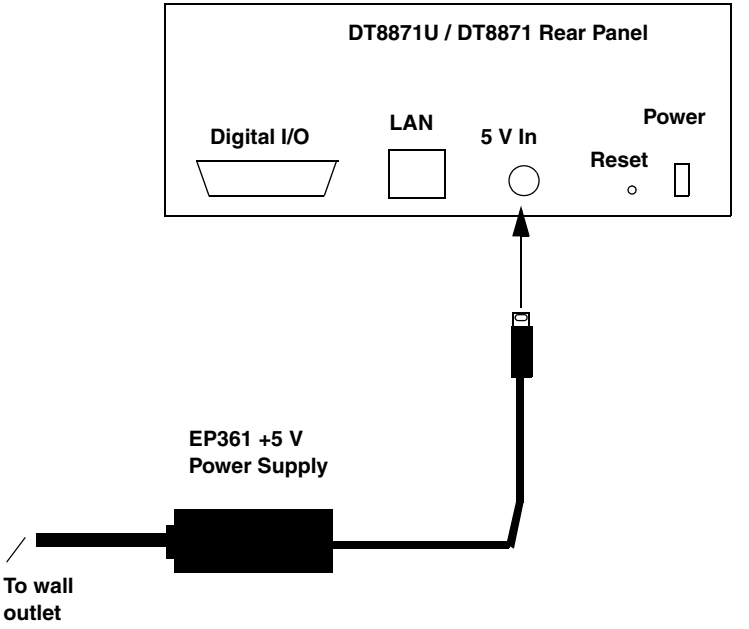


Figure 6: Attaching a +5 V Power Supply to the DT8871U or DT8871 Temperature Instrument

2. Plug the power supply into a wall outlet.

3. Press the Power switch on the rear panel of the instrument, shown in Figure 6, to turn on the DT8871U or DT8871 temperature instrument.
   The Power LED on the front panel lights to indicate that power is on.

Figure 7 shows the front panel of the DT8871U-48, including the locations of the LEDs.

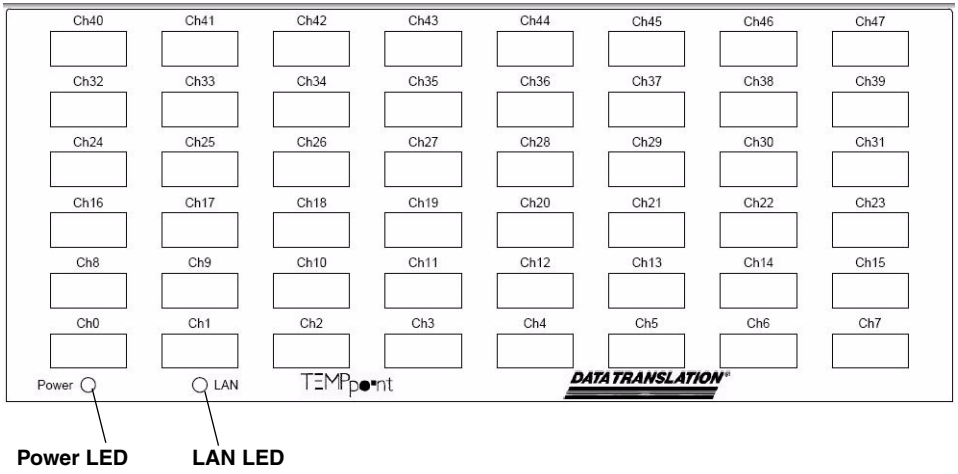


Figure 7: Front Panel of the DT8871U-48

Getting an IP Address and Host Name

Once your TEMPpoint instrument is connected to the LAN and powered on, the instrument automatically requests an Ethernet address from a DHCP (Dynamic Host Configuration Protocol) server, if available, and a host name from a DNS (Dynamic Domain Name Service) server, if available.

If these services are not available on the LAN, the TEMPpoint instrument uses Auto-IP to set up its TCP/IP configuration. In this case, the IP address will be in the range of 169.254.0.0 to 169.254.255.255 with a subnet mask of 255.255.0.0.

Note: If no DHCP server exists and your PC is set up to use a static IP address, you must temporarily reconfigure your PC to use Auto-IP, then configure your TEMPpoint instrument to use a static IP address, as described in Appendix D starting on page 167.

You can use the instrument's web interface, described in Chapter 5 starting on page 65, to see the IP address and host name that is assigned to your TEMPpoint instrument.

Note: When programming a TEMPpoint instrument, you access the instrument through its address string, which consists of an IP address or host name, such as **TCPIP0::192.43.218.69::inst0::INSTR** or **TCPIP0::192.43.218.69::SOCKET**. If a host name was returned by the DNS server, you can also address the instrument using its host name, such as **TCPIP0::arrakis.datx.com::inst0::INSTR.**

Note: For IVI-COM programmers, you can also assign a VISA alias to the instrument. For example, rather than addressing the instrument as **TCPIP0::192.43.218.69::inst0::INSTR**, you can use the VISA alias **TEMPpoint1** instead. See your VISA documentation for more information on VISA resource strings and creating VISA aliases.

Determining Ethernet Activity

You can use the ENet Link and ENet Activity LEDs on the rear of the TEMPpoint instrument, shown in Figure 8, with the LAN LED on the front of the TEMPpoint instrument, shown in Figure 7, to determine the Ethernet activity on your TEMPpoint instrument. Table 5 describes the meaning of these LEDs.

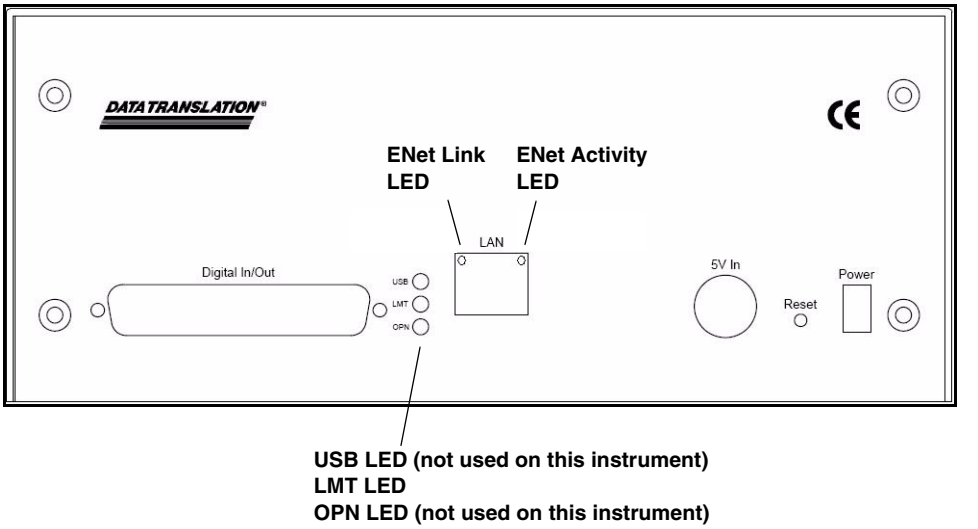


Figure 8: Rear Panel of the DT8871U or DT8871

Table 5: Using TEMPpoint LEDs to Determine Ethernet Activity

LEDs	Color	Description
LAN LED (on front panel)	Solid Green	TEMPpoint instrument has valid IP address.
	Blinking Green	TEMPpoint instrument identified using the Web interface; see page 75 for more information.
	Red	If the Ethernet link is operational, the instrument does not have a valid IP address. Otherwise, the Ethernet link is not operational.
ENet Link LED (on rear panel)	Yellow	Ethernet link operational.
	Off	Ethernet link not operational.
ENet Activity LED (on rear panel)	Green	Network traffic detected.
	Off	No network traffic detected.

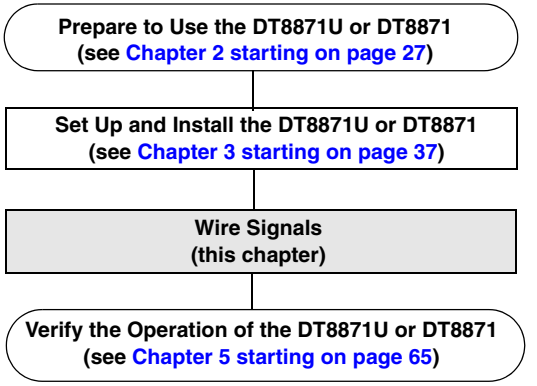
Resetting the Instrument

If needed, you can restore the default configuration of your TEMPpoint instrument by pressing the Reset pin on the rear panel of the instrument, shown in Figure 8 on page 48, until the LAN LED on the front panel turns off (which takes approximately 5 seconds), and then releasing the Reset pin.

The instrument reboots automatically using the factory-default LAN configuration (DHCP and auto-IP enabled); this process typically takes up to 40 seconds to complete. This forces the instrument to re-acquire an IP address from the DHCP server, or if that fails, to use Auto-IP to get an IP address.

Note: The default configuration overwrites any changes that you have made to the LAN configuration using the instrument's web interface.

Wiring Signals


Prepare to Use the DT8871U or DT8871
(see Chapter 2 starting on page 27)
Set Up and Install the DT8871U or DT8871
(see Chapter 3 starting on page 37)
Wire Signals
(this chapter)
Verify the Operation of the DT8871U or DT8871
(see Chapter 5 starting on page 65)

Preparing to Wire Signals

This section provides recommendations and information about wiring signals to the DT8871U or DT8871 temperature instrument.

Wiring Recommendations

Keep the following recommendations in mind when wiring signals to a DT8871U or DT8871 temperature instrument:

- Separate power and signal lines by using physically different wiring paths or conduits.
- To avoid noise, do not locate the TEMPpoint instrument and cabling next to sources that produce high electromagnetic fields, such as large electric motors, computer monitors, power lines, solenoids, and electric arcs, unless the signals are enclosed in a mumetal shield.
- Locate the TEMPpoint front panel as far away as possible from sources of high or low temperatures or strong air currents, such as fans.
- Prevent electrostatic discharge to the I/O while the TEMPpoint instrument is operational.
- Select an appropriate wire length and gauge for each thermocouple; in general, use the shortest wire length and largest gauge for the application to yield best results.
- Use shielded thermocouple wire for maximum rejection of electrical interference.

Warm-Up Time

For accurate temperature measurements, the DT8871 requires a warm-up time of 30 minutes for the analog circuitry to stabilize.

Signal Connections

Each DT8871U or DT8871 temperature instrument contains Cu-Cu thermocouple jacks for connecting thermocouple inputs, a 37-pin digital I/O connector, and an Ethernet connector for attaching to a host computer.

The remaining sections of this chapter describe how to attach thermocouple inputs, voltage inputs, and digital I/O signals to the the instrument.

Connecting Thermocouple Inputs

Depending on the model you purchased, you can connect up to 48 thermocouples input signals to the thermocouple jacks on the DT8871U or DT8871. Internally, these signals are connected in differential mode. You can mix and match the following thermocouple types across channels: B, E, J, K, N, R, S, and/or T.

Each Cu-Cu thermocouple input jack is polarized and accepts a mating Cu-Cu plug in the appropriate orientation. Table 6 lists the color designations for the + and – polarities of the supported thermocouple types for both the ANSI (American) and IEC (International) standards.

Table 6: Thermocouple Color Designation Standards

Thermocouple Standard	Thermocouple Type	Wire Color Coding + Polarity	Wire Color Coding – Polarity
ANSI	Type J	White	Red
	Type K	Yellow	Red
	Type T	Blue	Red
	Type E	Violet	Red
	Type S	Black	Red
	Type R	Black	Red
	Type B	Gray	Red
	Type N	Orange	Red

Table 6: Thermocouple Color Designation Standards (cont.)

Thermocouple Standard	Thermocouple Type	Wire Color Coding + Polarity	Wire Color Coding – Polarity
IEC	Type J	Black	White
	Type K	Green	White
	Type T	Brown	White
	Type E	Violet	White
	Type S	Orange	White
	Type R	Orange	White
	Type B	Gray	White
	Type N	Pink	White

For more information on thermocouple standards, refer to the following web site: http://www.omega.com/thermocouples.html.

Figure 9 shows how to connect a thermocouple input to channel 0 of the DT8871U or DT8871 temperature instrument.

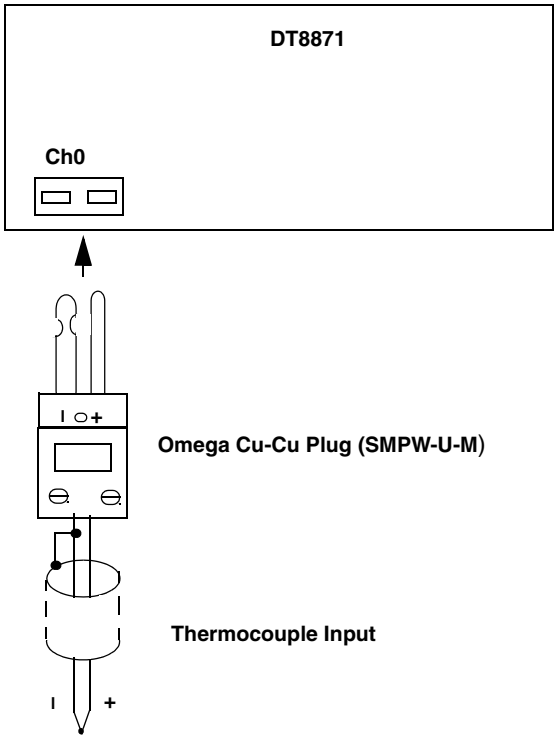


Figure 9: Connecting Thermocouple Inputs

Connecting Voltage Inputs

Figure 10 shows how to connect a differential voltage input to channel 0 of the DT8871U or DT8871 temperature instrument.

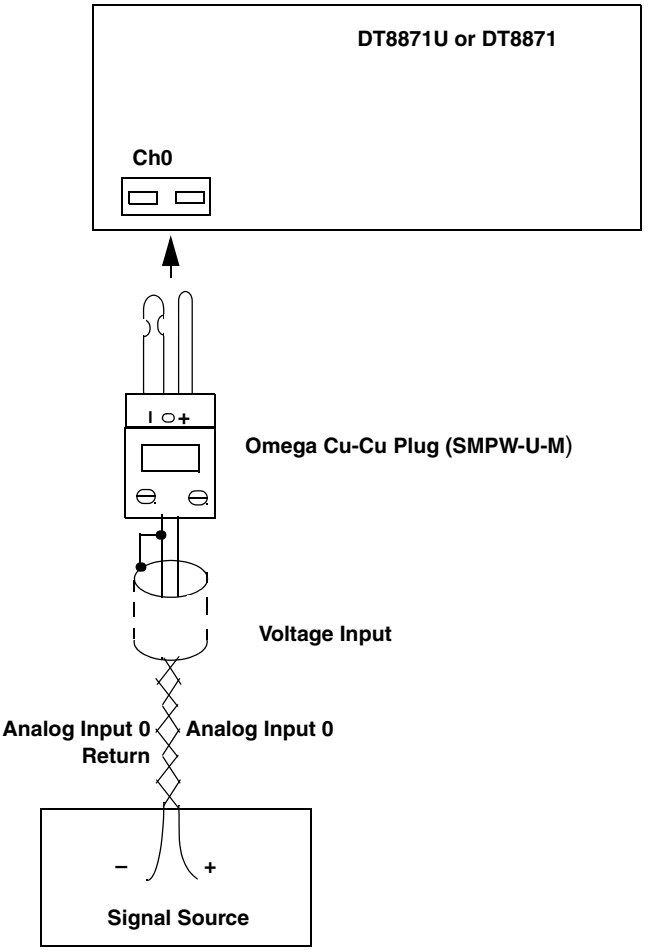


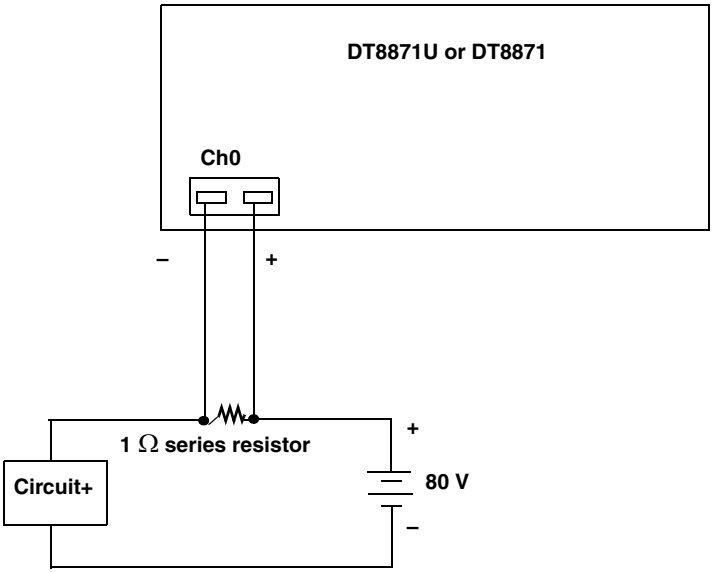
Figure 10: Connecting Voltage Inputs

Connecting Current Loop Inputs

In some applications, such as solar cell, fuel cell, and car battery testing applications, you may want to accurately sense and measure current in a high voltage loop.

The DT8871U and DT8871 instruments provide channel-to-channel isolation of ±500 V, meaning that each input can be referenced to ±500 V. For the DT8871U instrument, which has an input range of ±0.075 V, you can use a 1 Ω series resistor to measure ±0.075 A. Similarly, you can use a 0.1 Ω series resistor to measure ±0.75 A. For the DT8871 instrument, which has an input range of ±1.25 V, you can use a 1 Ω series resistor to measure ±1.25 A. Similarly, you can use a 0.1 Ω series resistor to measure ±12.5 A or a 10 Ω series resistor to measure ±0.125 A.

Figure 11 shows how to wire your signals to measure a current loop. In this example, the input is referenced to ±80 V.



Use a 1 Ω series resistor to convert current to voltage.

For the DT8871U version, 1 Ω = 0.075 A = 0.075 V.
For the DT8871 version, 1 Ω = 1.25 A = 1.25 V.

Figure 11: Connecting Current Loop Inputs

Connecting Digital I/O Signals

To make digital I/O connections easier, you can use the optional STP37 screw terminal panel and EP333 cable with your TEMPpoint instrument. Connect the STP37 to the digital I/O connector of the TEMPpoint instrument as shown in Figure 12:

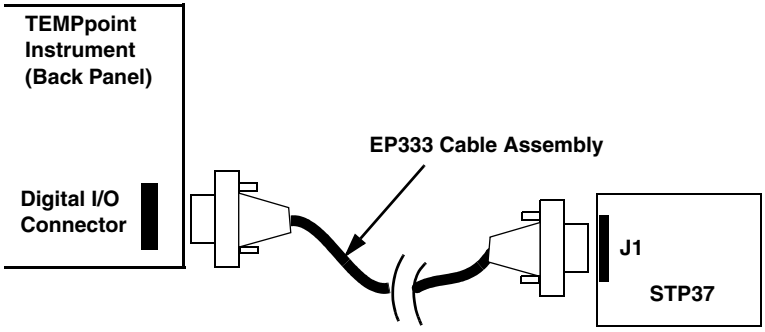


Figure 12: Connecting the DT8871 to the STP37

Figure 13 shows the layout of the STP37 screw terminal panel and lists the assignments of each screw terminal.

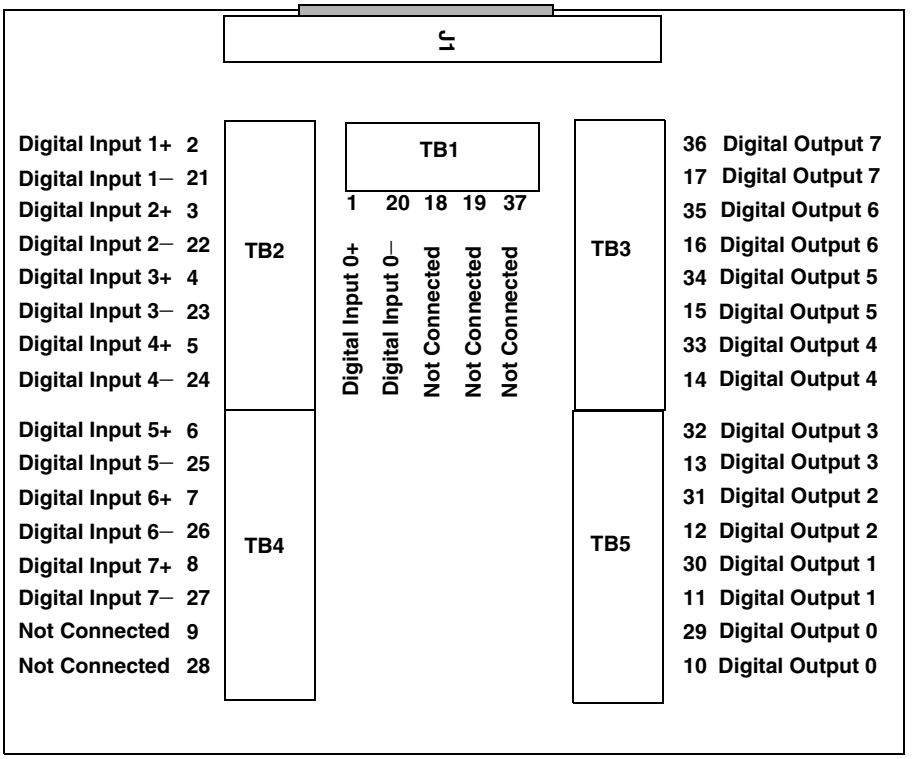
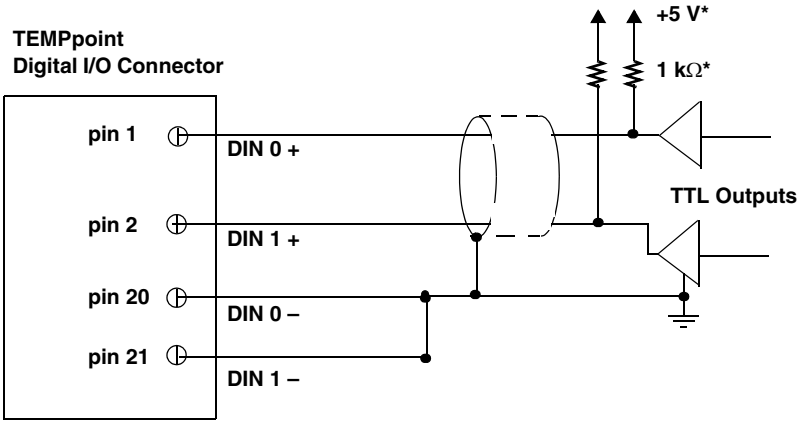


Figure 13: STP37 Screw Terminal Panel

Connecting Digital Input Signals

Figure 14 shows how to connect digital input signals (lines 0 and 1, in this case) to the digital I/O connector on the DT8871U or DT8871 temperature instrument.



*1 kΩ pull-up to +5 V required for TTL outputs.

Figure 14: Connecting Digital Inputs

Connecting Digital Output Signals

The digital output lines of the DT8871U and DT8871 instruments act as a solid-state relay. The customer-supplied signal can be ±30 V at up to 400 mA (peak) AC or DC.

You can use the digital output lines of the instrument to control solid-state or mechanical relays or high-current electric motors. Figure 15 shows how to connect digital output signals to line 0 of the DT8871U or DT8871 to control a motor relay.

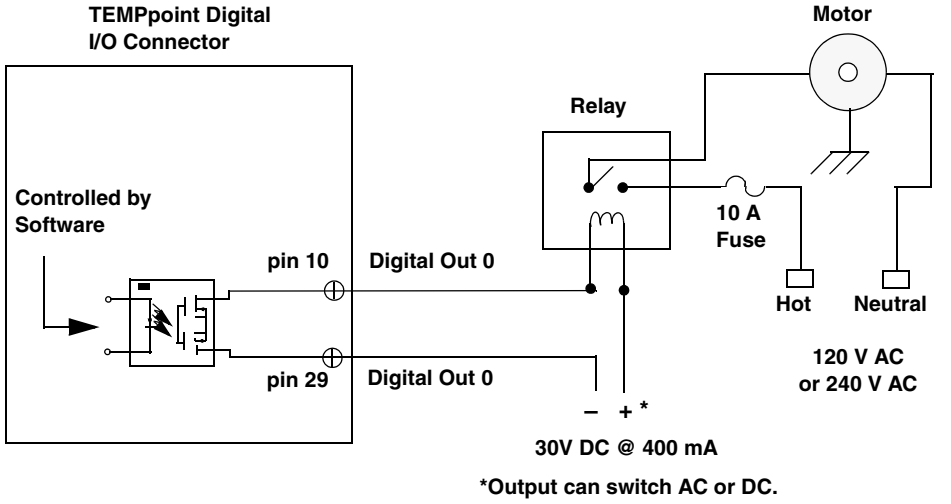
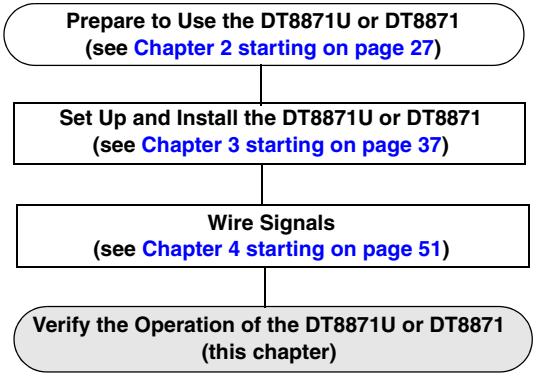


Figure 15: Switching up to 30 V at 400 mA

Verifying the Operation of the DT8871U or DT8871



You can verify the operation of the DT8871U or DT8871 temperature instrument using the instrument's web interface.

You can configure, measure, and control the DT8871U or DT8871 instrument either locally or remotely using this interface.

You can also use the provided TEMPpoint application, developed in Measure Foundry, for more complex data analysis. This chapter focuses on verifying your instrument using the web interface; refer to Appendix C starting on page 149 for information on using the TEMPpoint application with the DT8871U or DT8871.

Before Using the Web Interface

This section describes system requirements and browser settings for proper operation of the instrument's web interface.

Note: At any instant, up to 8 clients can access the TEMPpoint instruments concurrently using the web interface.

Up to 12 additional clients can access the TEMPpoint instruments concurrently using SCPI commands over VISA or sockets. Of these, 4 can be VXI-11 clients, which use the ::SOCKETS or VISA::INSTR resource to access the instrument.

At this time, the web and SCPI interfaces cannot be "locked;" therefore, one client can change the configuration of the instrument that another client is accessing. However, you can optionally lock the VXI-11 interface using the VISA APIs viLock/viUnlock; this prevents other VXI-11 clients (including VXI-11 discovery) from accessing the instrument. Refer to the SCPI documentation for your instrument for more information on supported SCPI commands.

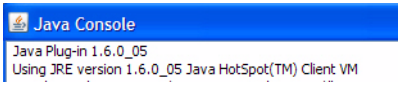
Java Requirements

Before using the instrument web interface, ensure that your computer has Version 6, Update 5 or greater of Java installed; this version of Java installs version 1.6 of the Java plug-in. To download or upgrade Java, go to www.java.com.

To verify that you have version 1.6 of the Java plug-in installed, do the following:

1. Launch version 6.0 or 7.0 of Internet Explorer.

2. From the Internet Explorer browser, select **Tools** -> **Sun Java Console**.
   The Java Console window appears.
3. Verify that version 1.6 or greater of the Java plug-in installed:



Internet Explorer Browser Settings

For proper operation of the instrument's web interface, ensure that your Internet Explorer 6.0 or 7.0 browser is configured as follows:

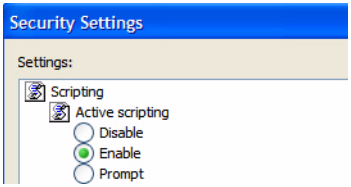
- JavaScript (Active Scripting) must be enabled
- Security level of the TEMPpoint instrument IP address must be Medium-high or lower
- Pop-up blockers must be disabled

The following sections describe how to configure these settings.

JavaScript

To enable JavaScript (also referred to as Active Scripting), perform the following steps:

1. From the Internet Explorer browser, select **Tools** -> **Internet Options**.
2. Click the **Security** tab.
3. Select **Internet**, and then click **Custom Level**.
4. Scroll down to the **Scripting** section.



5. Under **Active Scripting**, select **Enable**, and then click **OK**.

Security Levels

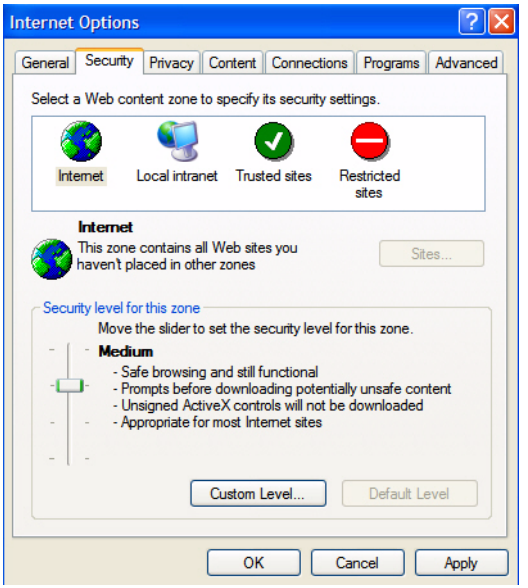
By default, the IP address of the TEMPpoint instrument is added to the Internet zone. If you'd rather leave the settings of the Internet zone at a level higher than Medium-high, then you can add the IP address of the TEMPpoint to either the Local intranet or Trusted sites zone and configure the security level of that zone to Medium-high or lower.

The following section describe how to configure each zone.

Internet Zone

To configure the security level of the TEMPpoint instrument's IP address in the Internet zone, perform the following steps:

1. From the Internet Explorer browser, select **Tools** -> **Internet Options**.
2. Click the **Security** tab.



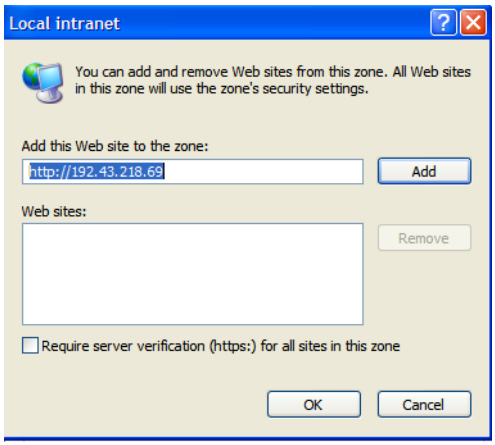
3. Select **Internet**, click **Default Level**, and move the slide bar to select a security level of Medium-high or lower.
4. Click **OK**.

Local Intranet Zone

To add the TEMPpoint IP address to the **Local intranet** zone and configure its security level, do the following:

1. From the Internet Explorer browser, select **Tools** -> **Internet Options**.
2. Click the **Security** tab.
3. Click **Local intranet**, and click **Sites**.
4. Select which web sites to add to the zone, and then click **Advanced**.

5. Enter the IP address of the TEMPpoint instrument to the zone, and click **Add**.

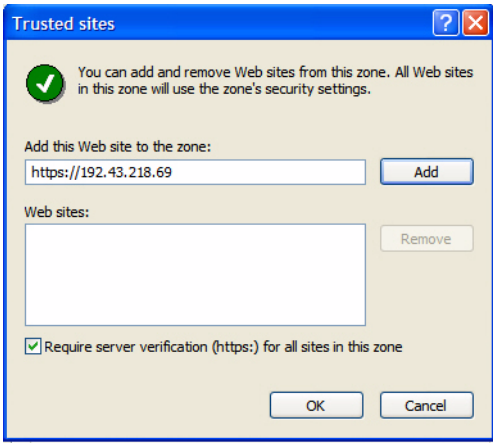


6. Click **OK**.
7. Click **Default Level**, and move the slide bar to select a security level of Medium-high or lower.
8. Click **OK**.

Trusted Sites Zone

To add the TEMPpoint IP address to the **Trusted sites** zone and configure its security level, do the following:

1. From the Internet Explorer browser, select **Tools** -> **Internet Options**.
2. Click the **Security** tab.
3. Click **Trusted sites**, and click **Sites**.
4. Enter the IP address of the TEMPpoint instrument to the zone (note that the address must be prefaced by (https://), and click **Add**.



5. Click **OK**.
6. Click **Default Level**, and move the slide bar to select a security level of Medium-high or lower.
7. Click **OK**.

Pop-up Blockers

To disable pop-up blockers, perform the following steps:

a. From the Internet Explorer browser, select **Tools** ->**Pop-up Blocker**.

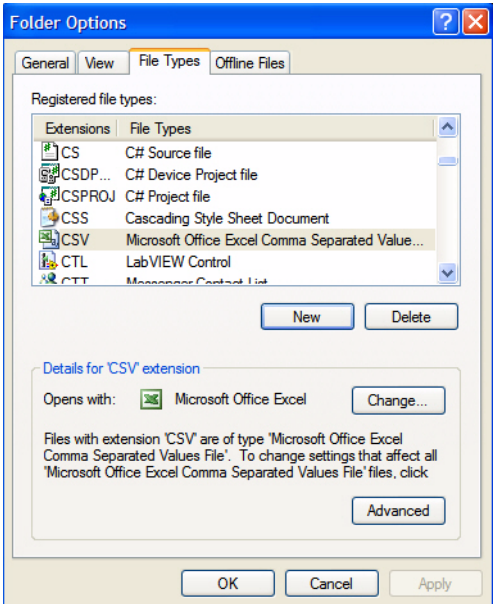
b. Select **Turn Off Pop-up Blocker**.

Associating CSV Files with Microsoft Excel or Notepad

If files with the .CSV extension do not have the proper file associations/actions set up, then clicking **Download** in the Download Measurements page of the instrument web interface will not present the option of saving the data to a file or loading the data to an application, such as Microsoft Excel® or Microsoft® Notepad, that can display it. Instead, the data will be displayed in the browser.

To associate a CSV file with Microsoft Excel or Notepad, perform the following steps:

1. From the Windows **Control Panel**, open the **Folder Options** dialog, and select **File Types**.
2. Scroll down to the **CSV** entry and select it. (If it is not in the list add it as a new file type by selecting **New** and entering **CSV**).
3. Click **Advanced** to access the Edit File Type dialog box.
4. Click **New** to access the New Action dialog box.
5. Enter **Open** in the **Action:** edit field.
6. Click **Browse** and find **Excel.exe** (typically located in C:\Program Files\Microsoft Office\OFFICExx\EXCEL.EXE) or **Notepad.exe** (typically located in C:\Windows\Notepad.exe) on your system, and then click **OK**.



7. Click **OK**.

Now when you click **Download** on the Download Measurements web page, you should see a dialog box asking if you want to Open or Save the data in the appropriate application.

Locating Your Instrument on the LAN

To access the web interface of your instrument, you must determine its IP address on your TCP/IP network.

Note: Discovery will work only for devices on the same subnet.

We recommend that you run Data Translation's Eureka Discovery Utility that is provided with the TEMPpoint software to locate your TEMPpoint instrument quickly. Alternatively, you can use other LXI discovery tools, such as Agilent Connection Expert, if you have them installed on your computer. Or you can check your router's address assignments or locate the instrument's MAC (Ethernet hardware) address in your DHCP server log.

To use the Eureka Discovery Utility, perform the following steps:

1. From the Windows Start menu, click **Programs -> Data Translation, Inc -> Instrument Support -> Eureka LXI Instrument Discovery**.
   A screen similar to the one shown in Figure 16 appears.

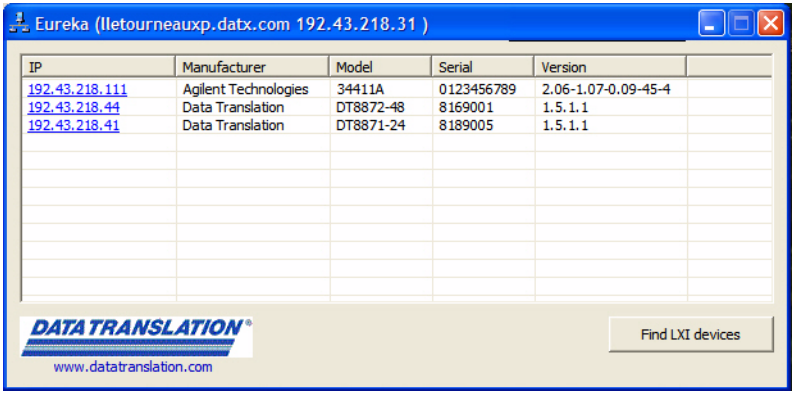
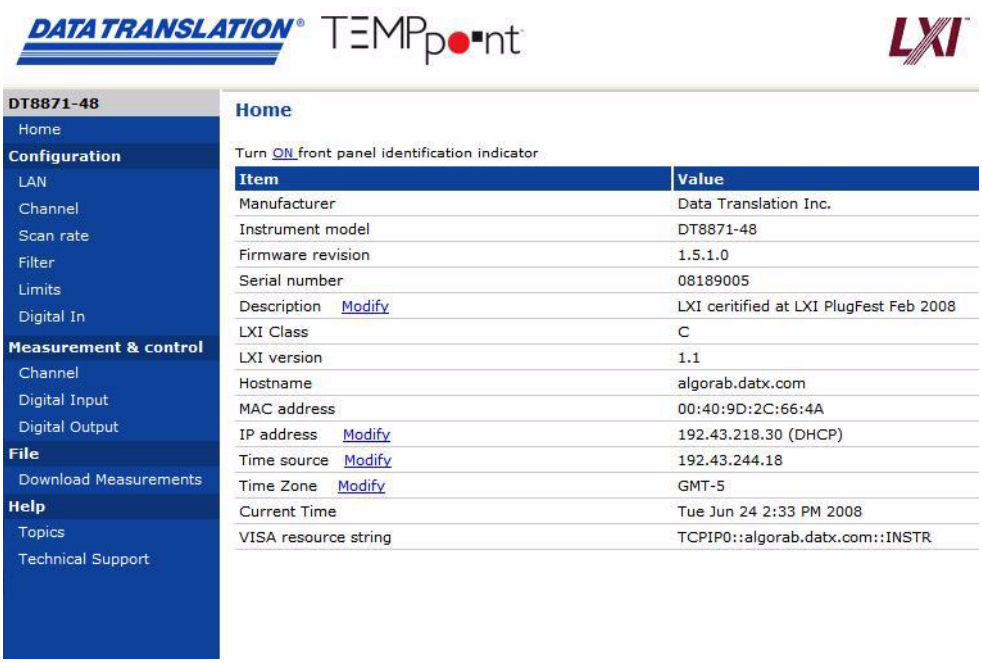


Figure 16: Eureka LXI Discovery Utility

2. Double-click the appropriate IP address to open the web pages for your instrument using your default web browser. Alternatively, you can enter the IP address of your instrument directly in your Internet Explorer address bar to see the instrument's web interface.

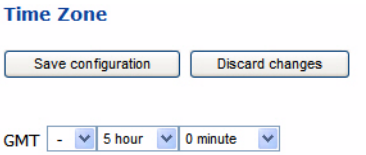
The main web page shows information about your TEMPpoint instrument on the network:



If you have multiple TEMPpoint instruments, you can click "Turn **ON** front panel identification indicator" to light the LAN LED on the instrument, described on page 45, to indicate the device you are using.

To change the description, IP address, or time source associated with the TEMPpoint instrument, click the **Modify** links to navigate to the LAN Configuration page, described on page 79.

To change the time zone associated with the TEMPpoint instrument, click the **Modify** link to bring up the following screen:



You specify the time zone that is used by the TEMPpoint instrument, as an offset (either + or –) from GMT (Greenwich Mean Time). The specified hour and minute is added to the UTC (Coordinated Universal Time) time that is maintained by the instrument. For example choosing –5 hours, 0 minutes sets the current time zone used by the instrument to five hours and 0 minutes behind GMT.

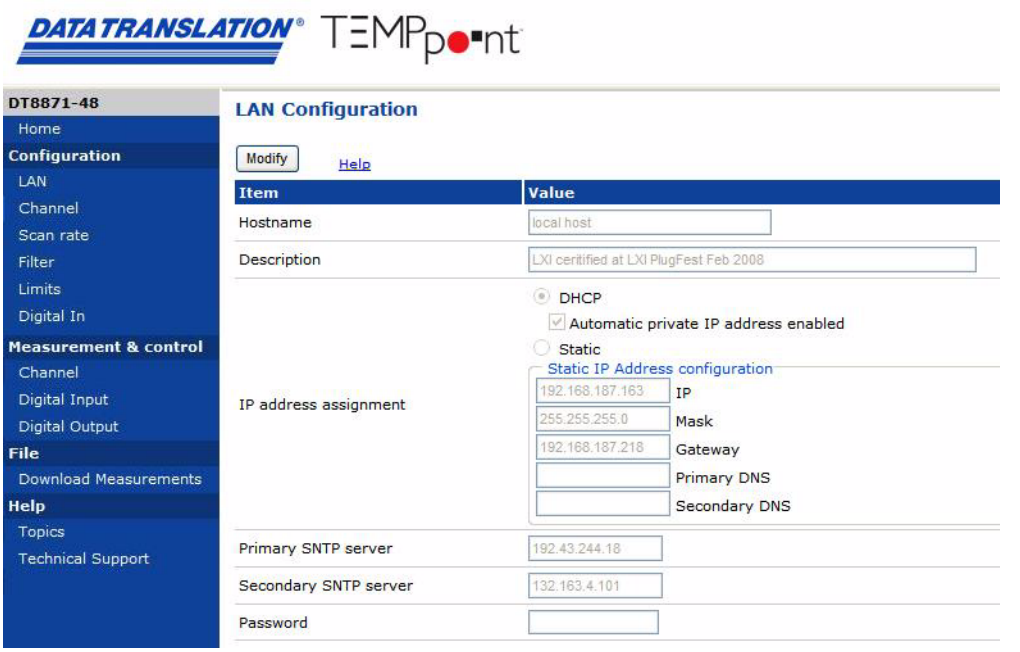
Configuring the Instrument

Web pages are provided for configuring the following aspects of your TEMPpoint instrument:

- Local Area Network (LAN) settings
- Channels that you want to measure
- Scan rate
- Filter
- Alarm limits
- Digital I/O lines

LAN Configuration

Use the **Configuration** -> **LAN** web page to configure the Local Area Network (LAN) settings for the TEMPpoint instrument:



When you first access your TEMPpoint instrument, the LAN settings that the instrument obtained through DHCP or AutoIP should be sufficient. If you need to make changes later, click the **Modify** button to enable changes.

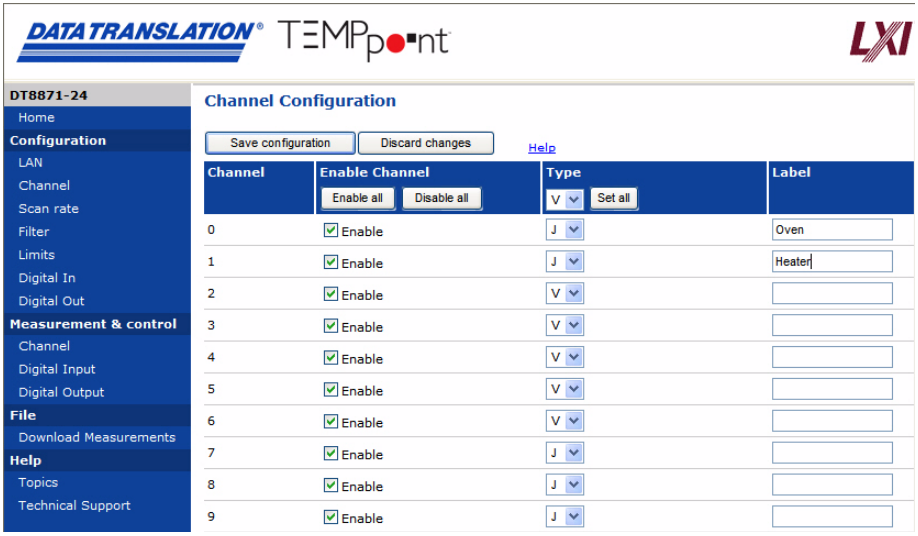
Note: If you want to assign a static IP address, ensure that you uncheck the checkbox called **Automatic private IP address enabled**.

When you click **Modify,** you must supply a password for the instrument. The username is **sysadmin;** it cannot be changed. The default password is **user.** You can change the password on this page. Note that the new password goes into effect after the device reboots. If you are prompted for a password before the device reboots, you must enter your original password.

Contact your system administrator and view the instrument's built-in help pages to determine the correct LAN settings.

Channel Configuration

Use the **Configuration** -> **Channel** web page to enable the channels that you want to measure, specify the sensor to use for each channel, and add a label to describe each channel, if desired:



To change your channel configuration, do the following:

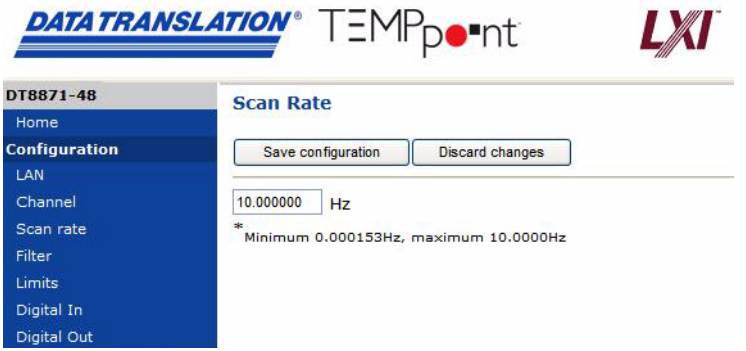
1. Under **Enable Channel,** check the boxes next to the channels that you want to collect data. You can use the **Enable All** and **Disable All** buttons for quick configuration of many channels.

2. Under **Type,** select the sensor type for each configured channel from the drop-down list boxes. You can use the **Set all** button to change all channels to the sensor type specified in the heading's drop-down list box.
3. Under **Label,** type text in the fields for each configured channel if you want to describe the channel.
4. Click **Save configuration** to apply your changes. If you do not save before leaving this page, your changes are lost.

You can also click the **Discard changes** button (before you save) to return to the previous configuration, if desired.

Scan Rate

Use the **Configuration** -> **Scan Rate** web page to set the scan rate for all channels on the instrument:



To change your instrument's scan rate, do the following:

1. Type a value, in Hertz, between the minimum and maximum shown in the Scan Rate field.

Note: The scan rate that you specify is rounded to the closest "correct" value that the instrument can accept without error. Internally, the 10 Hz clock is divided by an integer in the range of 1 to 65535 (the internal clock divider) to determine the closest value. When you save the scan rate configuration, the actual scan rate is shown.

2. Click **Save configuration** to apply your changes. If you do not save before leaving this page, your changes are lost.

You can also click the **Discard changes** button (before you save) to return to the previous configuration, if desired.

Filter Configuration

Use the **Configuration** -> **Filter** web page to configure the filter type used by the instrument:

You can choose one of the following filter types:

- **Raw** – No filter. Provides fast response times, but the data may be difficult to interpret. Use when you want to filter the data yourself.

The Raw filter type returns the data exactly as it comes out of the Delta-Sigma A/D converters. Note that Delta-Sigma converters provide substantial digital filtering above the Nyquist frequency.

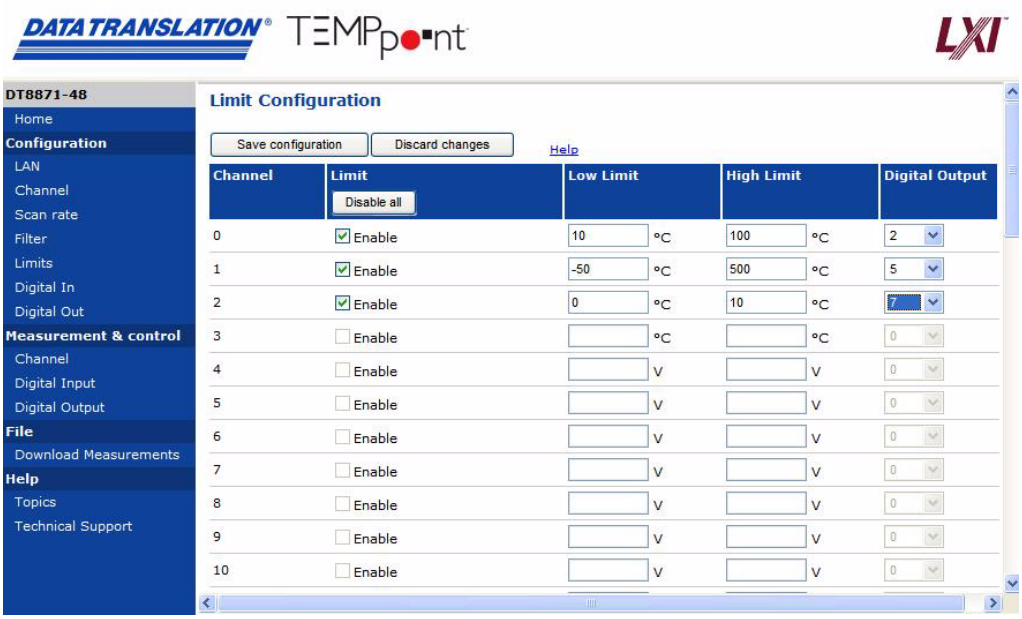
Generally, the only time it is desirable to use the Raw filter setting is if you are using fast responding thermocouples, sampling them at higher speeds (> 1 Hz), and need as much response speed as possible.

- **Moving average** – (The default filter setting for the DT8871U.) Provides a compromise of filter functionality and response time. This filter can be used in any application.

  This low-pass filter takes the previous 16 samples, adds them together, and divides by 16.

Alarm Limits Configuration

Use the **Configuration** -> **Limits** web page to define alarm conditions for specific enabled channels that you want to measure. If the alarm condition occurs, the specified digital output line is turned on:



To set up limit checking, do the following:

1. Under **Limit,** click the **Enable** buttons next to the channels for which you want to define limits. You can use the **Disable All** button to quickly stop limit checking on all channels. For each channel:
2. Type a value in the **Low Limit** text box.
3. Type a value in the **High Limit** text box.

4. (Optional) Select a **Digital Output** bit to set from the drop-down list box for this channel. This bit will be set active when the limit range is exceeded, high or low.

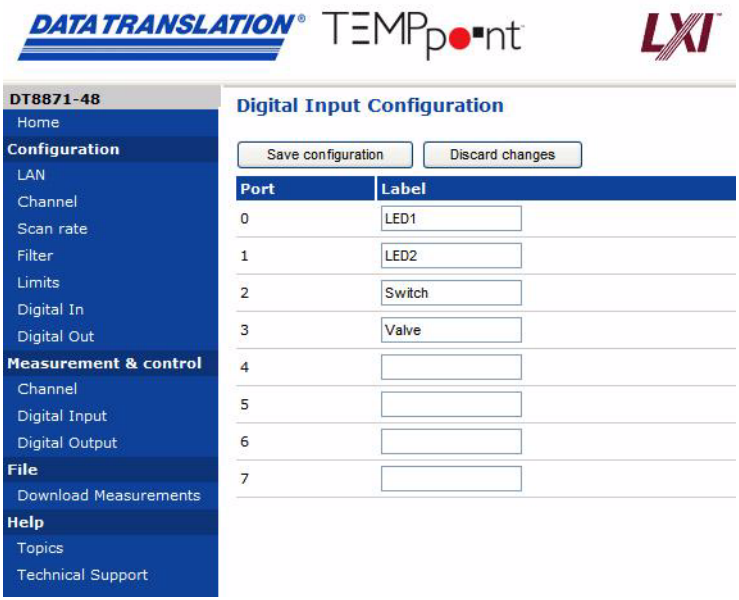
   When multiple channels are configured to set a digital output bit, a logical OR condition exists between them, and any value out of range sets the bit.

5. Click **Save configuration** to apply your changes. If you do not save before leaving this page, your changes are lost.

You can also click the **Discard changes** button (before you save) to return to the previous configuration, if desired.

Digital Input Configuration

Use the **Configuration** -> **Digital In** web page to configure the digital input lines of your TEMPpoint instrument:



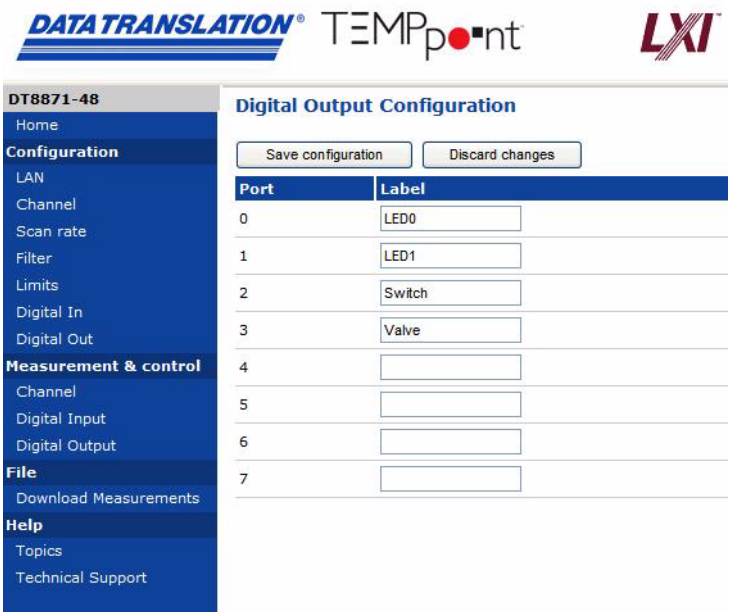
To change your digital input configuration, do the following:

1. Under **Label,** type text in the fields for each channel if you want to describe the channel.
2. Click **Save configuration** to apply your changes. If you do not save before leaving this page, your changes are lost.

You can also click the **Discard changes** button (before you save) to return to the previous configuration, if desired.

Digital Output Configuration

Use the **Configuration** -> **Digital Out** web page to configure the digital output lines of your TEMPpoint instrument:



To change your digital output configuration, do the following:

1. Under **Label,** type text in the fields for each channel if you want to describe the channel.
2. Click **Save configuration** to apply your changes. If you do not save before leaving this page, your changes are lost.

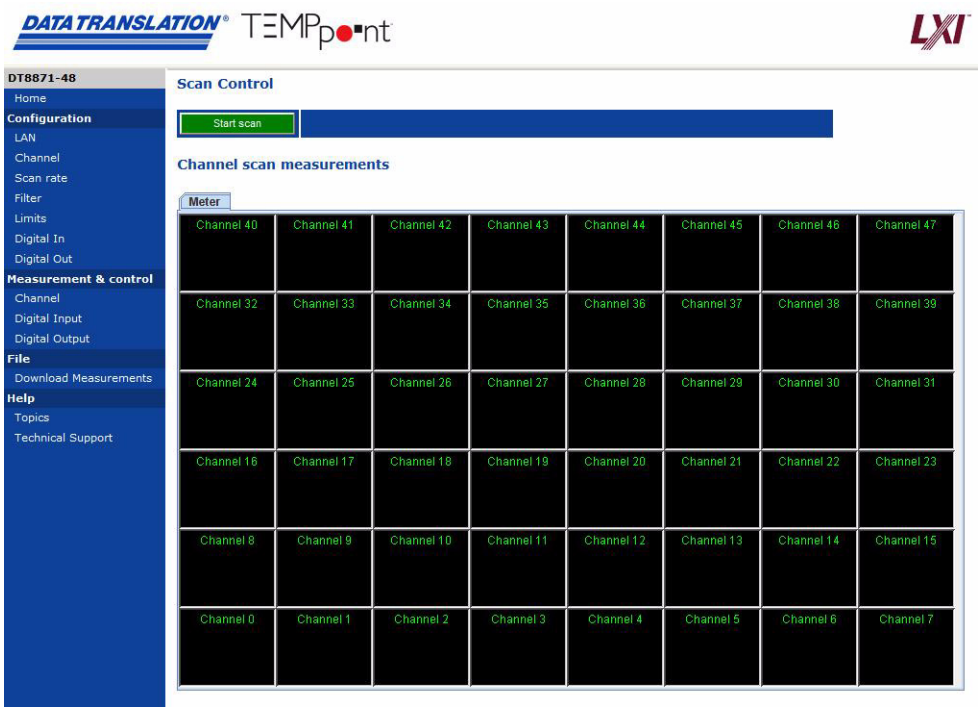
You can also click the **Discard changes** button (before you save) to return to the previous configuration, if desired.

Measuring Data and Controlling the Instrument

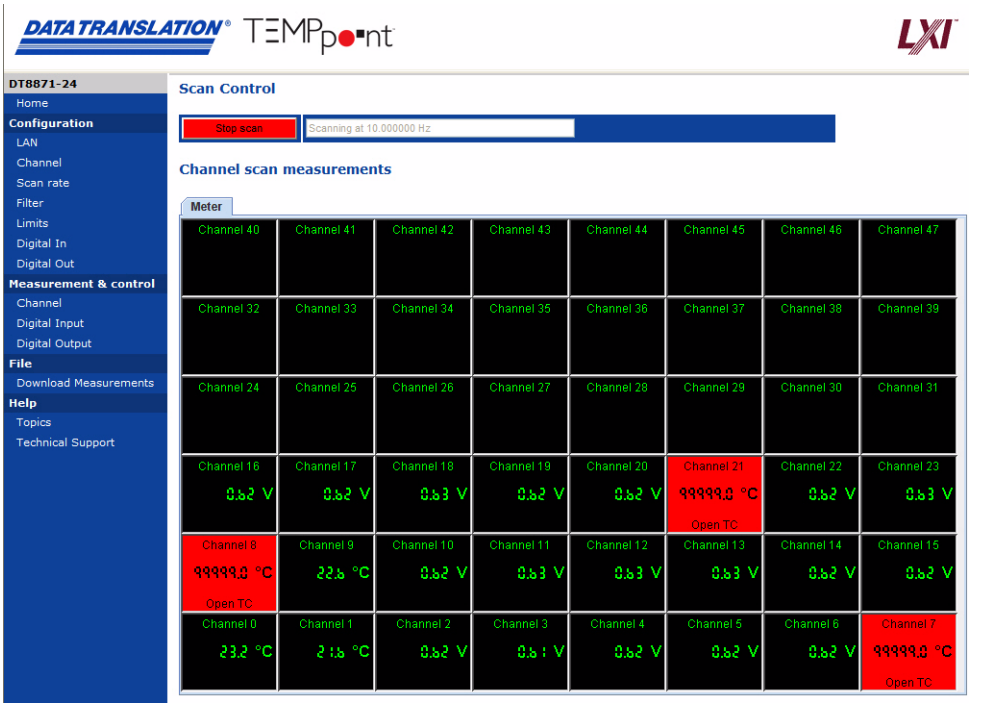
Use the Control web pages start or stop data acquisition on the sensor channels or to update the value of the digital output line.

Starting and Stopping a Scan

To start or stop a scan, use the **Measurement & control** -> **Channel** web page.



Press the **Start scan** button to begin acquiring data from the sensors. The measurements are displayed on the screen:



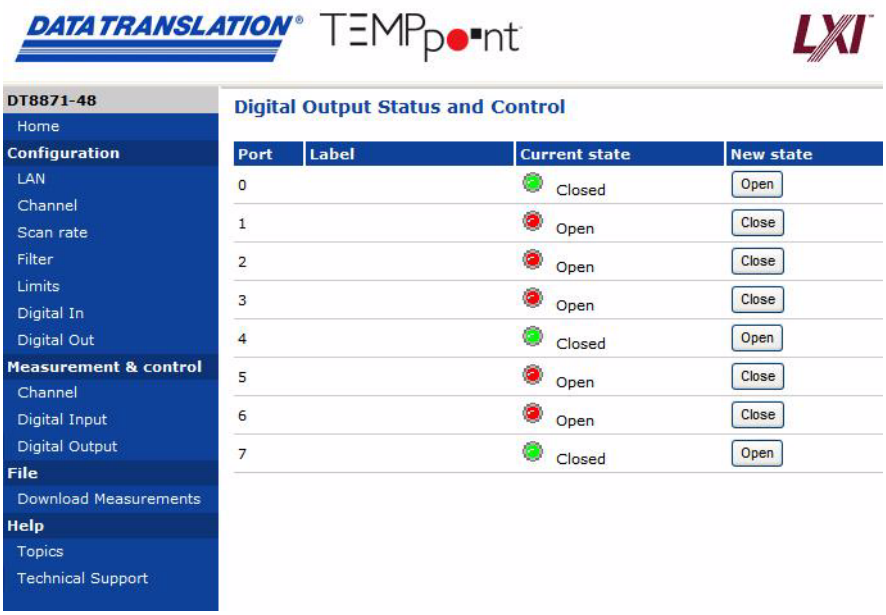
Notice the following aspects of the display:

- When acquiring data, the **Start scan** button changes to say **Stop scan** and the currently configured scan rate is displayed.
- Each box on the Meter tab represents one of the analog input channels, in the same position as the physical connectors.
- If you configured custom labels for some of the channels, those labels are shown here rather than the channel numbers.
- Red boxes indicate that the value is out of range for the specified RTD type.
- The values are updated only for the channels that you enabled, and at the scan rate you configured.

Press the **Stop scan** button to stop acquiring data from the sensors.

Controlling the Digital Outputs

Use the **Measurement & control** -> **Digital Output** web page to view the current state of the digital output lines, and manually change them if desired. Green indicates that the digital output line/relay is closed; red indicates that the digital output line/relay is open.

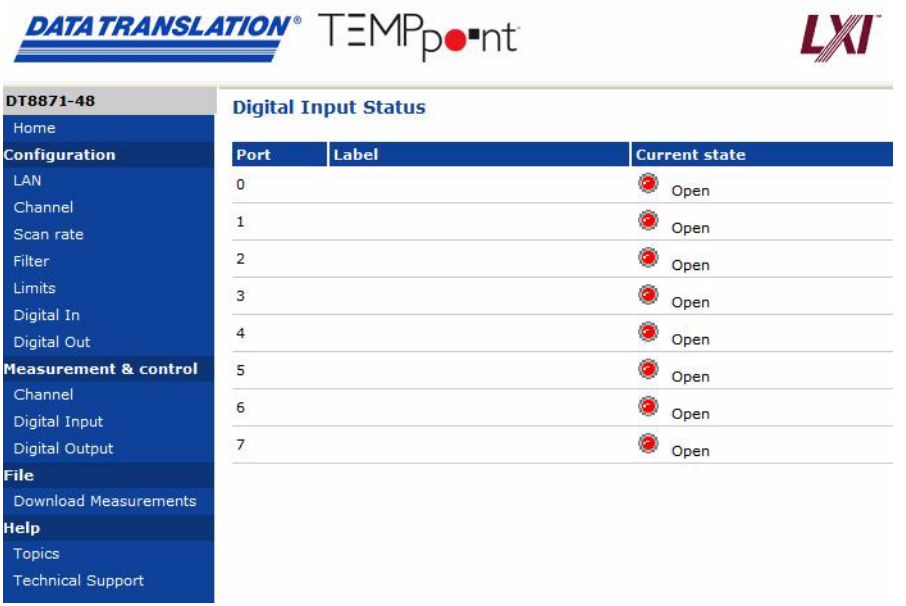


Note: You cannot change the configuration of digital output lines that were configured for limit checking on the **Configuration** -> **Limits** page.

To change the status of a digital output line/relay, click the **Open/Close** toggle buttons under the **Change State** heading for the digital output lines that you want to change. You can use these controls to activate or deactivate an external device based on criteria other than temperature that you define.

Reading the Digital Inputs

While the instrument is scanning, you can use the **Measurement & control** -> **Digital Input** web page to view the current value of the digital input port:



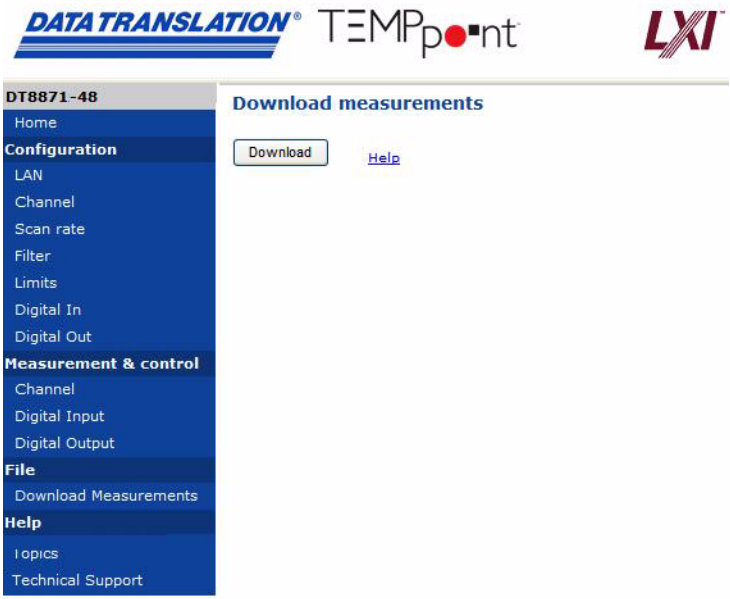
If you configured custom labels for the digital input lines, those labels are shown here.

The **Current state** LEDs show green if the digital input line is on (relay is closed) or red if the digital input line is off (relay is open).

Downloading Measurements

You can use the **File** -> **Download Measurements** web page to download your temperature measurement results, including timestamp and limit values, if applicable, to disk.

Note: Before using this feature, ensure that you have associated CSV files with Microsoft Excel or Notepad, described on page 73, or the data will be displayed in the browser and not saved to a file.

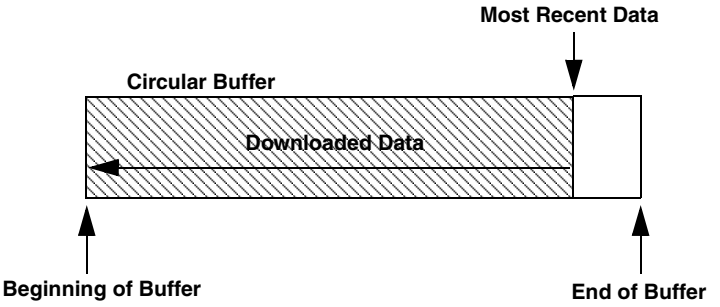


Measurements taken by the instrument are stored in a large circular buffer; when the buffer is full, the oldest data is overwritten with the most recent data.

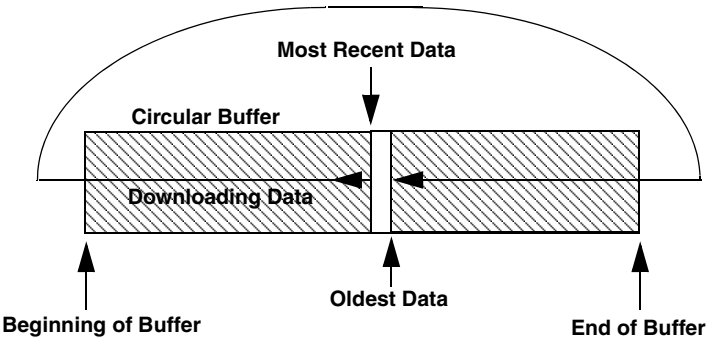
To download your data, do the following:

1. Click the **Download** button on this page.

   If scanning has been stopped, all the data in the buffer is downloaded to a comma-separated CSV file, starting with the most recent data.

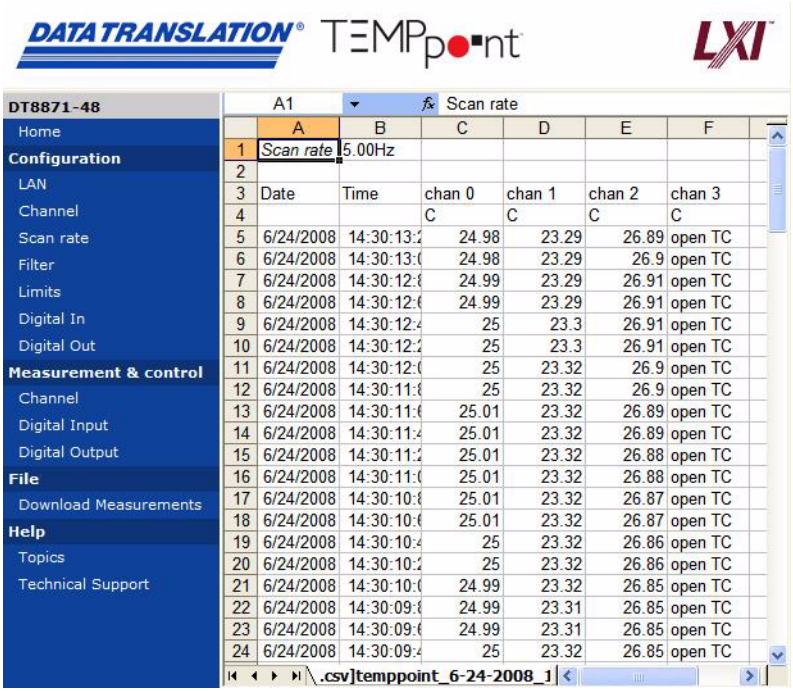


   If scanning is in progress, a snapshot of the data from the most recent data (at the time that the **Download** button was clicked) to the oldest data in the buffer is downloaded to a comma-separated CSV file.



2. In the resulting dialog box, choose **Open** or **Save.**
   - If you choose **Open,** the CSV file opens in the associated application (Microsoft Excel or Notepad).
   - If you choose **Save,** you can open the CSV file in Microsoft Excel, Notepad, or other utilities for analysis at a later time.

Under some circumstances, your data may be displayed in a frame in the browser, or Excel may open the data in the frame:



Change your Microsoft Excel, Microsoft Explorer, and Internet Explorer settings to turn off these behaviors and open your files directly in Excel.

Part 2: Using Your DT8871U or DT8871 Temperature Instrument

Principles of Operation

Figure 18 shows a block diagram of the DT8871U temperature instrument.

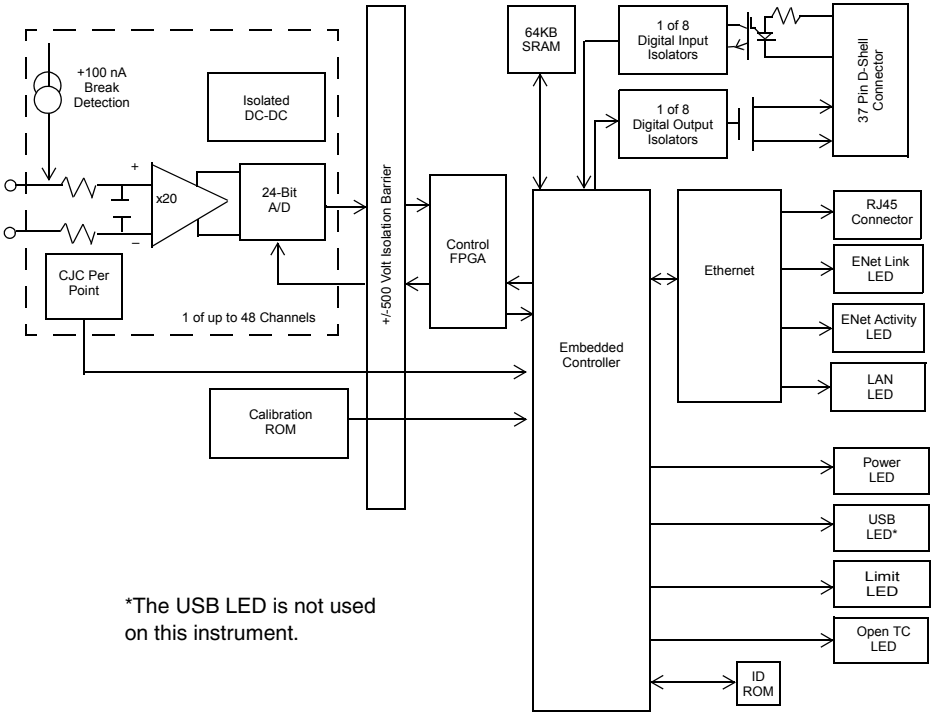


Figure 17: Block Diagram of the DT8871U Temperature Instrument

Figure 18 shows a block diagram of the DT8871 temperature instrument.

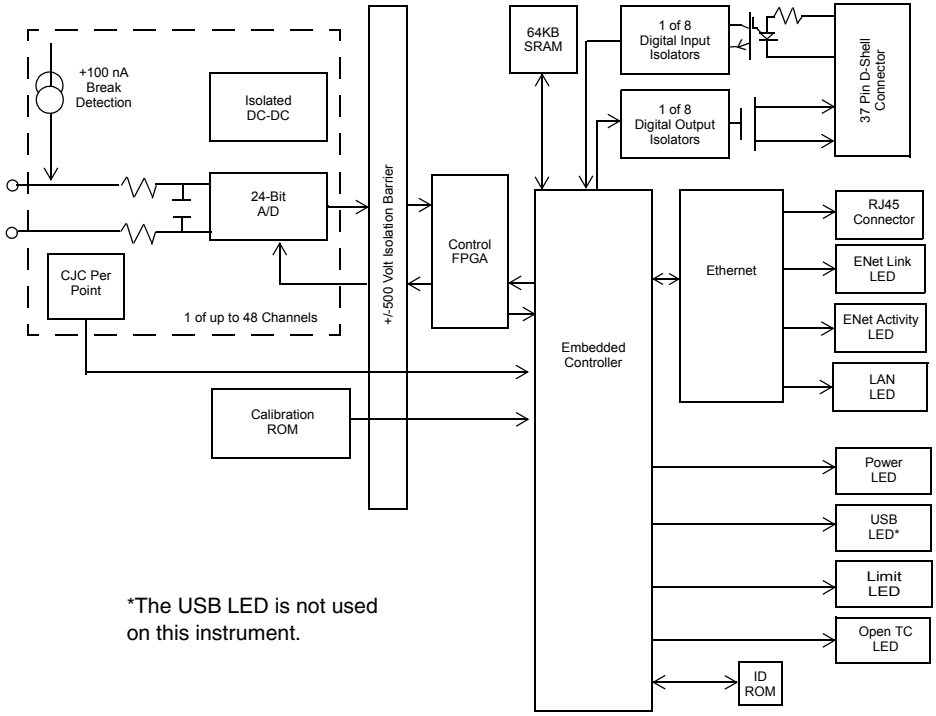


Figure 18: Block Diagram of the DT8871 Temperature Instrument

Analog Input Features

This section describes the following features of the analog input (A/D) subsystem on the DT8871U and DT8871 temperature instruments:

- Analog input channels, described below
- Cold junction compensation, described on page 105
- Open thermocouple detection, described on page 105
- Input ranges and out of range data, described on page 106
- Resolution, described on page 107
- Calibration, described on page 107
- Sample clock source, described on page 108
- Conversion modes, described on page 109
- Filtering, described on page 112
- Data format, described on page 113
- Error conditions, described on page 113

Analog Input Channels

The number of analog input channels that are available depends on the instrument model that you purchased, as shown in Table 3.

Table 3: Number of Analog Input Channels

Models	Number of Analog Input Channels
DT8871U-8 or DT8871-8	8 (numbered 0 to 7)
DT8871U-16 or DT8871-16	16 (numbered 0 to 15)
DT8871U-24 or DT8871-24	24 (numbered 0 to 23)
DT8871U-32 or DT8871-32	32 (numbered 0 to 31)
DT8871U-40 or DT8871-40	40 (numbered 0 to 39)
DT8871U-48 or DT8871-48	48 (numbered 0 to 47)

You can attach a voltage input or any of the following thermocouple types to these channels in a mix and match fashion: B, E, J, K, N, R, S, and/or T.

By default, all channels are configured for voltage inputs. You can specify the thermocouple types for channels over the LAN using the web interface, as described in "Channel Configuration" on page 81, in software using the Change Configuration dialog in the supplied TEMPpoint application, or by using an API call in your application program. You can also use standard SCPI commands over VISA or sockets, if desired.

Note: In a mix-and-match thermocouple system, it is easy to accidentally mismatch the software and hardware configuration for a channel. Therefore, it is recommended that you pay particular attention when configuring channels, since the resultant errors may be not large enough to notice initially, but may be significantly larger than the accuracy specification for the instrument.

Since each channel has its own 24-bit A/D, analog inputs are measured simultaneously. Using the DT8871U or DT8871 temperature instrument, you can acquire data from a single analog input channel, acquire a single value from all the analog input channels simultaneously, or continuously acquire data from one or more analog input channels simultaneously using a channel list. Refer to page 109 for more information on specifying the channels for each of these conversion modes.

Table 4 lists the supported measurement range for each thermocouple type.

Table 4: Supported Measurement Range for Each Thermocouple Type

Thermocouple Type	Supported Measurement Range	
	Minimum	Maximum
B	0° C (32° F)	1820° C (3308° F)
E	–200° C (–328° F)	1000° C (1832° F)
J	–210° C (–346° F)	1200° C (2192° F)
K	–200° C (–328° F)	1370° C (2498° F)
N	–200° C (–328° F)	1300° C (2372° F)
R	–50° C (–58° F)	1750° C (3182° F)
S	–50° C (–58° F)	1750° C (3182° F)
T	–200° C (–328° F)	400° C (752° F)

Refer to Appendix A for the thermocouple accuracy of the DT8871U and DT8871 over the dynamic range of the instrument.

Cold Junction Compensation

Each analog input channel has its own cold-junction compensation (CJC) at the input. The software reads the value of the CJC input along with the value of the analog input channel and automatically corrects for errors based on the specified thermocouple type and the thermocouple linearization data stored in onboard ROM.

A separate multiplexed A/D is used to acquire all the CJC input values. The software takes care of correlating the CJC measurements with the analog input measurements.

Note: The TEMPpoint software provides the option of returning CJC values in the data stream. This option is seldom used, but is provided if you want to implement your own temperature conversion algorithms in software when using continuous operations. Refer to page 113 for more information on this feature.

Open Thermocouple Detection

Break detection circuitry (+100 nA) is provided to ensure that open thermocouples are detected. The Open (OPN) LED on the rear panel lights when this condition occurs; see Figure 8 on page 48 for the location of this LED.

In addition, the software returns the value SENSOR_IS_OPEN (99999 decimal) for any channel that was configured for a thermocouple input and has either an open thermocouple or no thermocouple connected to it. This value is returned anytime a voltage greater than 100 mV is measure on the input, since this value is greater than any legitimate thermocouple voltage.

If the channel is configured for a voltage input (not a thermocouple type), the Open (OPN) LED never lights and the SENSOR_IS_OPEN value is not returned. Instead, the voltage value is returned. If no input is connected to the channel, the software returns a value of approximately 0.7 V due to the open thermocouple detection pull-up circuit.

Input Ranges and Out of Range Data

The DT8871U instrument provides an input range of ±0.075 V, while the DT8871 instrument provides an input range of ±1.2500 V.

Each thermocouple type has an allowable voltage range. If a voltage is measured on the input that is outside of the legal range for the selected thermocouple type, the channel may be configured for the wrong type of thermocouple or something other than a thermocouple may be connected to the channel.

For channels configured with a thermocouple type of None (voltage), the Limit (LMT) LED on the rear panel of the DT8871 temperature instrument lights to alert you when the voltage is out of range; see Figure 8 on page 48 for the location of this LED.

For channels configured with a thermocouple type other than None (voltage), the LMT LED lights when the temperature limit is out of range for the specified thermocouple type.

In addition, if the input voltage is less than the legal voltage range for the selected thermocouple type, the software returns the value TEMP_OUT_OF_RANGE_LOW (–88888 decimal). If the input voltage is greater than the legal voltage range for the selected thermocouple type, the software returns the value TEMP_OUT_OF_RANGE_HIGH (88888 decimal).

Note: If you are continuously measuring from a properly configured thermocouple input channel and the thermocouple opens or becomes disconnected, the open thermocouple pull-up circuit causes the input voltage to rise to approximately 0.7 V over a few seconds.

In this case, the temperature value rises very quickly, and you will receive the TEMP_OUT_OF_RANGE_HIGH (88888 decimal) value followed by the OPEN_SENSOR (99999 decimal) value. In this case, the OPN LED lights when the open thermocouple is detected and the LMT LED lights when the temperature limit is out of range for the thermocouple type.

Resolution

The resolution of the analog input channels is fixed at 24 bits; you cannot specify the resolution in software.

Calibration

Your TEMPpoint temperature instrument is factory-calibrated to meet or exceed its published specifications using standards traceable to NIST. A two-step calibration process is used. First, the A/D on each channel is calibrated for offset and gain; these values (including the zero point) are stored in ROM. Second, each CJC circuit is calibrated.

In addition, the DT8871U and DT8871 temperature instruments auto-calibrate on each power-up cycle to guarantee high-accuracy measurements. This process, also known as auto-zeroing, resets the zero point of each A/D. You can also auto-calibrate the instrument at any time (as long as acquisition is not in progress) using a software command. Refer to your software documentation for more information on the auto-calibration feature.

While TEMPpoint instruments were designed to preserve high accuracy measurements over time, it is recommended that your instrument be recalibrated every year to ensure that it meets or exceeds specifications.

You can calibrate your TEMPpoint instrument in the field using precise calibration equipment and the TEMPpoint Calibration Utility, described on page 20. Optionally, you can return your instrument to Data Translation for recalibration. For information on factory recalibration, contact Data Translation at 508-481-3700, ext. 1323 (if you are in the USA) or call your local distributor (if you are located outside the USA); see our web site (www.datatranslation.com) for the name and telephone number of your nearest distributor.

Sample Clock Source

The DT8871U and DT8871 temperature instruments support an internal clock with a maximum sampling rate of 10 Samples/s.

Use software to specify an internal clock source and a clock frequency between 0.000152590219 Hz and 10.0 Hz.

Note: The clock frequency that you specify is rounded to the closest "correct" value that the instrument can accept without error. Internally, the 10 Hz clock is divided by an integer in the range of 1 to 65535 (the internal clock divider) to determine the closest value. Using software, you can query this setting to determine the actual clock frequency that is used.

When the continuous operation is started, all the channels specified in the channel list are read simultaneously at the specified clock frequency.

Conversion Modes

The DT8871U and DT8871 temperature instruments support simultaneous single value and continuous scan conversion modes for reading the values of the analog input channels.

This section describes each of these conversion modes.

Simultaneous Single-Value Operations

If you want a snapshot of all the analog input channels at one point in time, you can perform a simultaneous single-value operation, also called a single values operation, using SCPI commands.

Note: This operation mode is supported in SCPI only; it is not supported by the IVI-COM driver or the instrument's web interface.

Use one of the **:MEASure** SCPI commands to specify the channels that you want to sample and the configuration of the channels, if needed. (Refer to Table 3 on page 103 for a list of the available channels for your instrument model.) One single value is then acquired from each analog input channel simultaneously and returned.

If you need to continuously acquire data from one or more channels use continuous scan mode, described next, instead.

Continuous Scan Mode

Continuous scan mode takes full advantage of the capabilities of the DT9871 temperature instrument. Use continuous scan mode if you want to accurately control the period between successive simultaneous conversions of specific channels.

In addition to the analog input channels, this conversion mode allows you to read the digital input port (all 8 digital input lines) as part of the analog input data stream. This feature is particularly useful when you want to correlate the timing of analog and digital events.

Specifying Channels for a Continuous Scan Operation

Using software, enable the analog input channels that you want to sample by specifying the channel numbers in the channel list. You can also read the value of the digital input port through the analog input data stream by specifying the digital input channel in the channel list; the number of the digital input channel depends on the instrument model that you are using, as shown in Table 5.

Table 5: Supported Channels for Continuous Operations

Models	Analog Input Channels	Channel for Reading the Digital Input Port
DT8871U-8 or DT8871-8	0 to 7	8
DT8871U-16 or DT8871-16	0 to 15	16
DT8871U-24 or DT8871-24	0 to 23	24
DT8871U-32 or DT8871-32	0 to 31	32
DT8871U-40 or DT8871-40	0 to 39	40
DT8871U-48 or DT8871-48	0 to 47	48

The channels are read in order from the lowest channel number to the highest channel number in the list of enabled channels; this process is known as a scan.

How Continuous Scan Works

When you issue a command to start the scan, the TEMPpoint instrument simultaneously samples all the analog input channels, CJC inputs, and the digital input port, and converts the analog inputs to temperature or voltage based on the thermocouple type. If the channel is enabled, the sampled data is placed in the FIFO on the instrument.

On the DT8871U and DT8871, the FIFO is used as a circular buffer. Acquisition continues indefinitely until you stop the operation. When the FIFO is full, the operation wraps to the beginning of the FIFO; values are overwritten starting at the first location in the FIFO. It is up to your application to retrieve the data from the FIFO; refer to your software documentation for more information.

The conversion rate is determined by the frequency of the input sample clock; refer to page 108 for more information about the input sample clock. The sample rate, which is the rate at which a single entry in the channel list is sampled, is the same as the conversion rate due to the simultaneous nature of the TEMPpoint instrument.

Figure 19 illustrates scanning a list of three enabled channels: channel 0, channel 1, and channel 2. In this example, analog input data is acquired simultaneously on each clock pulse of the input sample clock. Data is acquired continuously.

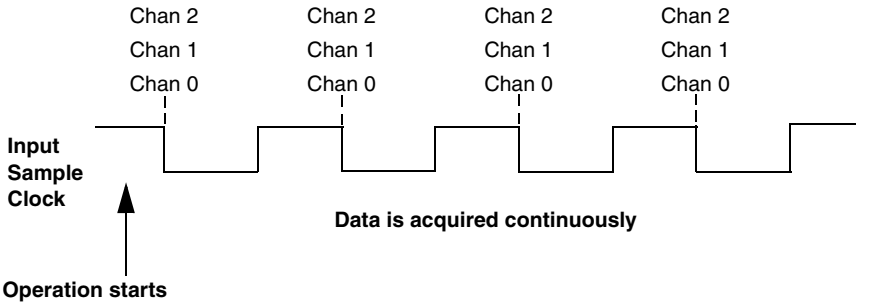


Figure 19: Continuous Scan Mode

Filtering

The DT8871U and DT8871 instruments use a Delta-Sigma analog-to-digital converter (ADC) for each analog input channel to provide simultaneous sampling of all inputs. The Delta-Sigma converter operates at 10 Hz effectively providing a filter that rejects 50 Hz and 60 Hz power line frequency components and that removes *aliasing*, a condition where high frequency input components erroneously appear as lower frequencies after sampling.

In addition to the filter provided in hardware, you can further reduce noise by selecting one of the following filter options in software: Moving Average or Raw. Refer to page 83 and to your software documentation for more information on selecting a filter type.

Data Format

DT8871U and DT8871 instruments return data as 32-bit floating-point values. If you specify a thermocouple type of None (voltage), a voltage value (in the range of ±0.075 V for the DT8871U and ±1.25 V for the DT8871) is returned. For all other thermocouple types, a temperature value, in degrees C, or one of the error constants, described on page 113, is returned.

In normal operation, one floating-point value is returned for each enabled channel (including the digital input port). If you enable the capability of returning CJC data in the data stream, described on page 105, two floating-point values are returned in the data stream for each enabled analog input channel. The first value in the pair represents the temperature (or voltage) of the channel; the second value in the pair represents the CJC temperature (in degrees C) for that channel.

Error Conditions

The DT8871U and DT8871 instruments report any overrun errors by sending an overrun event to the application program. If this error condition occurs, the instrument stops acquiring and transferring data to the host computer. To avoid this error, try one or more of the following:

- Reduce the sample rate
- Close any other applications that are running
- Run the program on a faster computer

Additionally, the following constants may be reported to the host:

- 99999.0 – SENSOR_IS_OPEN, described on page 105
- 88888.0 – TEMP_OUT_OF_RANGE_HIGH, described on page 106
- –88888.0 – TEMP_OUT_OF_RANGE_LOW, described on page 106

If any of these constants is reported, the A/D subsystem continues to acquire data; the error condition is cleared when the data falls within range.

Digital I/O Features

The DT8871U and DT8871 instruments provide 8 digital input lines and 8 digital output lines that you can use to control external equipment, including solid-state or mechanical relays.

This section describes the following digital I/O features of the DT8871U and DT8871 temperature instruments:

- Digital input lines, described below
- Digital output lines, described on page 116
- Channel-to-channel isolation, described on page 117
- Resolution, described on page 117
- Operation modes, described on page 118

Digital Input Lines

The DT8871U and DT8871 temperature instruments feature eight, isolated, digital input lines.

Digital inputs operate from +3 to +28 V DC, with a switching time of 2 ms maximum. Figure 20 shows the digital input circuitry; a 2.2 kΩ resistor is used in series with the LED in the opto-isolator input.

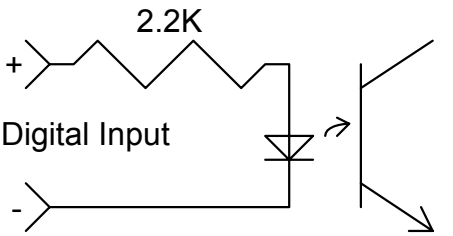


Figure 20: Digital Input Circuitry

A digital line is high (switch is closed) if its value is 1; a digital line is low (switch is open) if its value is 0.

Digital Output Lines

The DT8871U and DT8871 temperature instruments feature eight, latched and isolated digital output lines. The outputs are solid-state relays that operate at ±30 V and 400 mA peak (AC or DC). Switching time is 2 ms maximum.

Figure 21 shows the digital output circuitry.

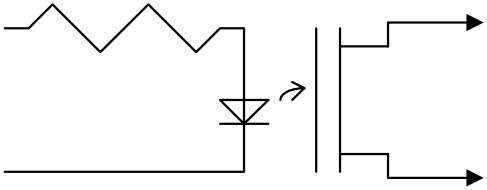


Figure 21: Digital Output Circuitry

Digital outputs resemble a switch; the switch is closed if the state of the digital output line is 1, and the switch is open if the state of the digital output line is 0. On power up or reset, the digital outputs are disabled.

Channel-to-Channel Isolation

The DT8871U and DT8871 instruments include channel-to-channel isolation of up to 250 V between digital I/O lines. If you require greater channel-to-channel isolation, use every other digital line. This reduces the number of digital I/O lines, but provides channel-to-channel isolation of 500 V (one channel can be +250 V while the adjacent channel can be –250 V).

Resolution

The DT8871U and DT8871 instruments provide a resolution of 8 bits for the digital input port to accommodate the 8 digital input lines and a resolution of 8 bits for the digital output port to accommodate the 8 digital output lines. These lines are organized as isolated, dedicated ports. You cannot configure port resolution through software.

Operation Modes

Using software, you can read from a single digital input line or the entire digital input port, or write to a single digital output line or the entire digital output port. You can also return the value of the entire digital input port in the analog input data stream if you want to correlate analog input data with digital events; refer to page 109 for more information.

Troubleshooting

General Checklist

Should you experience problems using a DT8871U or DT8871 temperature instrument, do the following:

1. Read all the documentation provided for your product. Make sure that you have added any "Read This First" information to your manual and that you have used this information.
2. Check the TEMPpoint CD for any README files and ensure that you have used the latest installation and configuration information available.
3. Check that your system meets the requirements stated in Chapter 2.
4. Check that you have installed your hardware properly using the instructions in Chapter 3.
5. Check that you have wired your signals properly using the instructions in Chapter 4.
6. Check that you have installed Java and configured your web browser appropriately using the instructions on page 67.
7. Search the DT Knowledgebase in the Support section of the Data Translation web site (at www.datatranslation.com) for an answer to your problem.

If you still experience problems, try using the information in Table 6 to isolate and solve the problem. If you cannot identify the problem, refer to page 125.

Table 6: Troubleshooting Problems

Symptom	Possible Cause	Possible Solution
DT8871U or DT8871 is not found.	The DT8871U or DT8871 cannot communicate with the network.	Ensure that your DT8871U or DT8871 is properly connected; see the instructions in Chapter 3.
		If your PC has a static IP address, reconfigure it for Auto-IP using the instructions on page 168.
		Check your LAN configuration; see the instructions on page 79.
		Check the IP address of the instrument by opening a Command Prompt window (Start -> Programs -> Accessories -> Command Prompt) and entering the command "ipconfig /all". The IP settings of your instrument are returned.
		Ping the instrument by opening a Command Prompt window (Start -> Programs -> Accessories -> Command Prompt) and entering the command "ping address", where *address* is the IP address of your instrument. If a timeout message is returned, the IP address is incorrect. If a "no host" error message is returned, the subnet mask is incorrect. Refer to page 46 for more information on IP and subnet addresses.
		If needed, reset the instrument using the instructions on page 50.

Table 6: Troubleshooting Problems (cont.)

Symptom	Possible Cause	Possible Solution
DT8871U or DT8871 does not respond.	The DT8871U or DT8871 configuration is incorrect.	Check your LAN configuration; see the instructions on page 79.
		Check the IP address of the instrument by opening a Command Prompt window (Start -> Programs -> Accessories -> Command Prompt) and entering the command "ipconfig /all". The IP settings of your instrument are returned.
		Ping the instrument by opening a Command Prompt window (Start -> Programs -> Accessories -> Command Prompt) and entering the command "ping address", where *address* is the IP address of your instrument. If a timeout message is returned, the IP address is incorrect. If a "no host" error message is returned, the subnet mask is incorrect. Refer to page 46 for more information on IP and subnet addresses.
		If needed, reset the instrument using the instructions on page 50.
	The DT8871U or DT8871 is damaged.	Contact Data Translation for technical support; refer to page 125.

Table 6: Troubleshooting Problems (cont.)

Symptom	Possible Cause	Possible Solution
Intermittent operation.	Loose connections or vibrations exist.	Check your wiring and tighten any loose connections or cushion vibration sources; see the instructions in Chapter 4.
	The DT8871U or DT8871 is overheating.	Check environmental and ambient temperature; consult the specifications on page 141 of this manual and the documentation provided by your computer manufacturer for more information.
	Electrical noise exists.	Check your wiring and either provide better shielding or reroute unshielded wiring; see the instructions in Chapter 4.

Table 6: Troubleshooting Problems (cont.)

Symptom	Possible Cause	Possible Solution
Data appears to be invalid.	An open connection exists.	Check your wiring and fix any open connections; see the instructions in Chapter 4.
	A transducer is not connected to the channel being read.	Check the transducer connections; see the instructions in Chapter 4.
	The RTD or voltage input that you connected to the channel does not match the software configuration for that channel.	Check your wiring and ensure that what you specify in software matches your hardware configuration; see the instructions in Chapter 4.
	Your TEMPpoint instrument may need recalibration.	The TEMPpoint instrument is calibrated at the factory. Thereafter, yearly calibration is recommended. Use the TEMPpoint Calibration Utility, described on page 20, or return your instrument to Data Translation for recalibration. For information on TEMPpoint factory recalibration, contact Data Translation at 508-481-3700, ext. 1323 (if you are in the USA) of call your local distributor (if you are located outside the USA); see our web site (www.datatranslation.com) for the name and telephone number of your nearest distributor.

Technical Support

If you have difficulty using a DT8871U or DT8871 temperature instrument, Data Translation's Technical Support Department is available to provide technical assistance.

To request technical support, go to our web site at http://www.datatranslation.com and click on the Support link.

When requesting technical support, be prepared to provide the following information:

- Your product serial number
- The hardware/software product you need help on
- The version of the TEMPpoint CD you are using
- Your contract number, if applicable

If you are located outside the USA, contact your local distributor; see our web site (www.datatranslation.com) for the name and telephone number of your nearest distributor.

If Your DT8871U or DT8871 Needs Factory Service

If your DT8871U or DT8871 temperature instrument must be returned to Data Translation, do the following:

1. Record the instrument's serial number, and then contact the Customer Service Department at (508) 481-3700, ext. 1323 (if you are in the USA) and obtain a Return Material Authorization (RMA).

   If you are located outside the USA, call your local distributor for authorization and shipping instructions; see our web site (www.datatranslation.com) for the name and telephone number of your nearest distributor. All return shipments to Data Translation must be marked with the correct RMA number to ensure proper processing.

2. Using the original packing materials, if available, package the instrument as follows:

   – Wrap the DT8871U or DT8871 in an electrically conductive plastic material. Handle with ground protection. A static discharge can destroy components on the instrument.

   – Place in a secure shipping container.

3. Return the DT8871U or DT8871 to the following address, making sure the RMA number is visible on the outside of the box.

   Customer Service Dept.
   Data Translation, Inc.
   100 Locke Drive
   Marlboro, MA 01752-1192

Specifications

Analog Input Specifications

The analog input specifications for the DT8871U and DT8871 instruments are organized as follows:

- Basic instrument specifications – listed on this page
- Thermocouple specifications – listed on page 129
- Isolation and protection specifications – listed on page 135
- Memory specifications – listed on page 136
- Temperature stability specifications – listed on page 137
- Voltage measurement specifications – listed on page 138

Basic Instrument Specifications

Table 7 lists the basic instrument specifications for the DT8871U and DT8871 temperature instruments.

Table 7: Basic Instrument Specifications

Feature	Specifications
Number of channels in channel list	
DT8871U-8 and DT8871-8:	9 (8 differential analog inputs, 1 digital input port)
DT8871U-16 and DT8871-16:	17 (16 differential analog inputs, 1 digital input port)
DT8871U-24 and DT8871-24:	25 (24 differential analog inputs, 1 digital input port)
DT8871U-32 and DT8871-32:	33 (32 differential analog inputs, 1 digital input port)
DT8871U-40 and DT8871-40:	41 (40 differential analog inputs, 1 digital input port)
DT8871U-48 and DT8871-48:	49 (48 differential analog inputs, 1 digital input port)
A/D converter type	24-bit Sigma-Delta

A

Thermocouple Specifications

Table 8 lists the thermocouple specifications for the analog input subsystem on the DT8871U and DT8871 temperature instruments.

Table 8: Thermocouple Specifications

Feature	Specifications
Thermocouple types (software-selectable)	B, E, J, K, N, R, S, T
A/D resolution	24-bits
Sample rate	10 Samples/s
Thermal disturbance channel-to-channel	None
Upscale break detection current	+100 nA
System temperature error DT8871U: DT8871:	 See Table 9 on page 130 See Table 10 on page 132

System Temperature Error for the DT8871U

Table 9 lists the accuracy of the DT8871U for each thermocouple type at several temperature points over the dynamic range of the instrument.

Table 9: Calculated Thermocouple Accuracy of the DT8871U

Input Temp.	Thermocouple Type[a]							
	J	K	T	E	S	R	B	N
–100° C	±0.17°C	±0.17°C	±0.16°C	±0.16°C	----------	----------	----------	±0.16°C
0° C	±0.15°C	±0.16°C	±0.16°C	±0.15°C	±0.2°C	±0.2°C	----------	±0.16°C
100° C	±0.18°C	±0.15°C	±0.16°C	±0.15°C	±0.18°C	±0.18°C	----------	±0.15°C
300° C	±0.15°C	±0.17°C	±0.16°C	±0.15°C	±0.18°C	±0.18°C	±0.23°C	±0.15°C
500° C	±0.15°C	±0.15°C	----------	±0.15°C	±0.18°C	±0.17°C	±0.21°C	±0.15°C
700° C	±0.15°C	±0.15°C	----------	±0.16°C	±0.18°C	±0.18°C	±0.17°C	±0.16°C
900° C	±0.15°C	±0.17°C	----------	±0.17°C	±0.18°C	±0.18°C	±0.19°C	±0.16°C
1100° C	±0.15°C	±0.16°C	----------	----------	±0.19°C	±0.18°C	±0.18°C	±0.16°C
1400° C	----------	----------	----------	----------	±0.18°C	±0.18°C	±0.17°C	----------

a. **Conditions for accuracy measurements:**
Warm-up time of 30 minutes.
Inclusive of typical 0.15°C CJC error (maximum CJC error is 0.25°C).
Inclusive of typical 0.25 µV offset error (maximum offset error is 2.5 µV).
Exclusive of thermocouple errors.
Exclusive of noise (see Figure 22 and Figure 23 for more information about system noise).

The histograms shown in Figure 22 and Figure 23 characterize the Gaussian system noise distribution for each of the available filter types on the DT8871U. Note that converting µV error to temperature error depends on thermocouple type. For example, a K thermocouple changes approximately 39 µV per degrees C; therefore, a noise level of 0.1 µV adds less than 0.003° C error (0.1 µV / 39 µV) for a type K thermocouple.

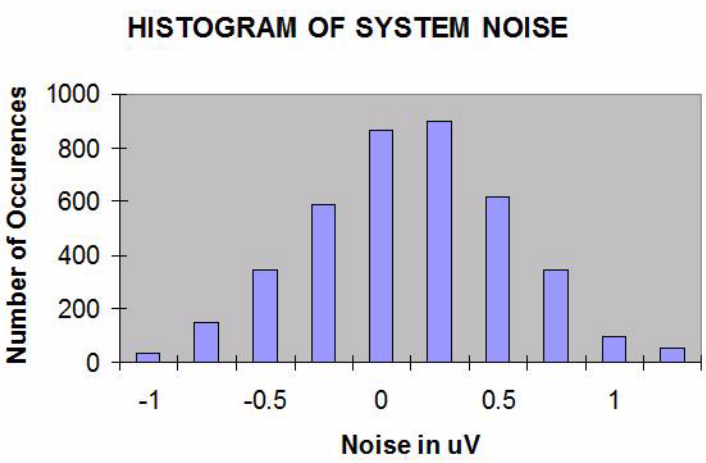


Figure 22: System Noise on the DT8871U Using No Software Filter (Raw Filter)

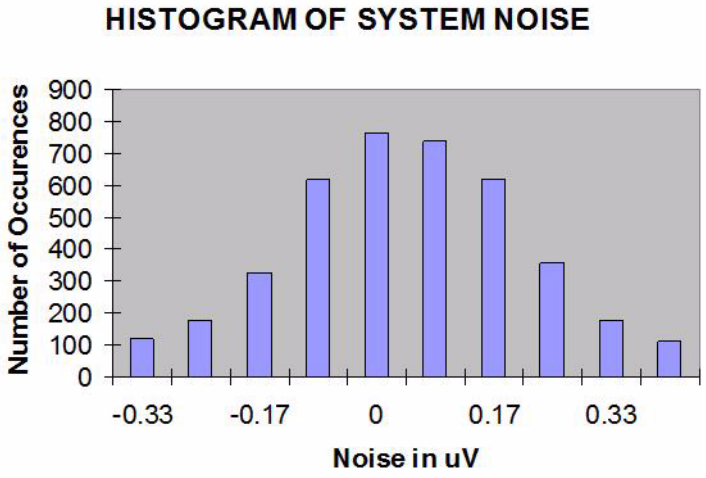


Figure 23: System Noise on the DT8871U Using the Moving Average Filter

System Temperature Error for the DT8871

Table 10 lists the accuracy of the DT8871 for each thermocouple type at several temperature points over the dynamic range of the instrument.

Table 10: Calculated Thermocouple Accuracy of the DT8871

Input Temperature	Thermocouple Type[a]							
	J	K	T	E	S	R	B	N
–100° C	±0.33°C	±0.37°C	±0.38°C	±0.31°C	----------	----------	----------	±0.44°C
0° C	±0.3°C	±0.33°C	±0.33°C	±0.28°C	±1.12°C	±1.14°C	----------	±0.39°C
100° C	±0.31°C	±0.29°C	±0.31°C	±0.27°C	±0.88°C	±0.86°C	----------	±0.35°C
300° C	±0.29°C	±0.34°C	±0.29°C	±0.26°C	±0.75°C	±0.71°C	±1.84°C	±0.33°C
500° C	±0.28°C	±0.31°C	----------	±0.26°C	±0.71°C	±0.66°C	±1.2°C	±0.33°C
700° C	±0.27°C	±0.3°C	----------	±0.27°C	±0.68°C	±0.63°C	±0.92°C	±0.33°C
900° C	±0.27°C	±0.34°C	----------	±0.28°C	±0.66°C	±0.6°C	±0.8°C	±0.33°C
1100° C	±0.28°C	±0.34°C	----------	----------	±0.64°C	±0.58°C	±0.71°C	±0.34°C
1400° C	----------	----------	----------	----------	±0.62°C	±0.56°C	±0.64°C	----------

a. **Conditions for accuracy measurements:**
Warm-up time of 30 minutes.
Inclusive of typical 0.2°C CJC error (maximum CJC error is 0.3°C).
Inclusive of typical 5 µV offset error (maximum offset error is 50 µV).
Exclusive of thermocouple errors.
Exclusive of noise (see Figure 24 and Figure 25 for more information about system noise).

The histograms shown in Figure 24 andFigure 25 characterize the Gaussian system noise distribution for each of the available filter types on the DT8871. Note that converting µV error to temperature error depends on thermocouple type. For example, a K thermocouple changes approximately 39 µV per degrees C; therefore, a noise level of 10 µV adds 0.3° C error (10 µV / 39 µV) for a type K thermocouple.

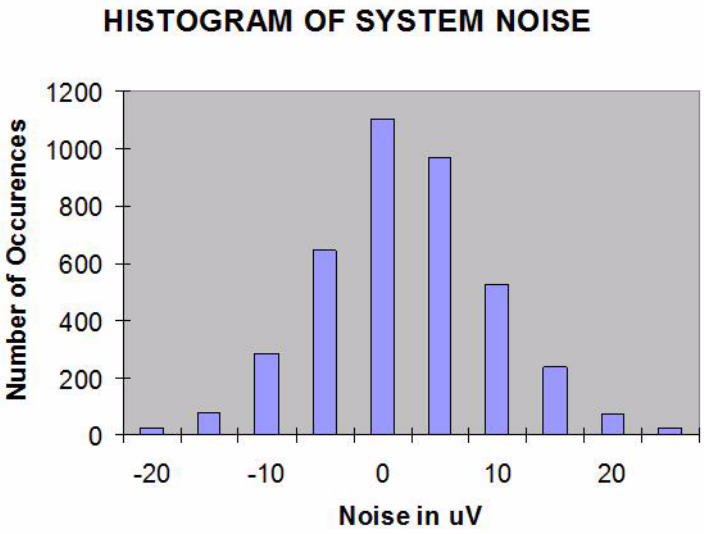


Figure 24: System Noise on the DT8871 Using No Software Filter (Raw Filter)

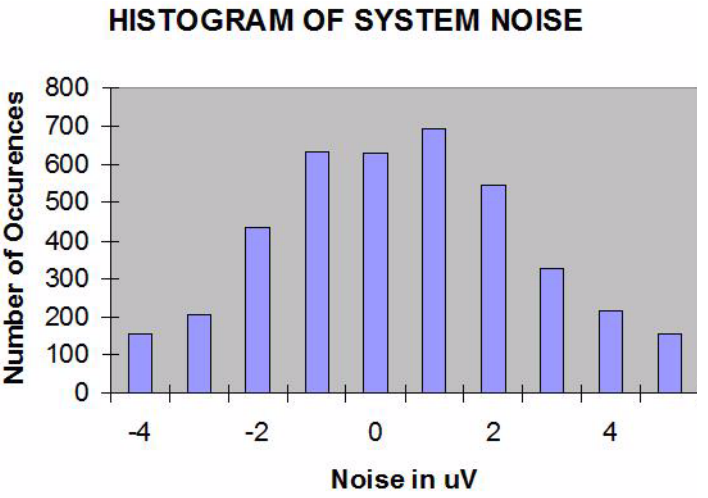


Figure 25: System Noise on the DT8871 Using the Moving Average Filter

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Isolation and Protection Specifications

Table 11 lists the isolation and protection specifications for the analog input subsystem on the DT8871U and DT8871 temperature instruments.

Table 11: Isolation and Protection Specifications

Feature	Specifications
Overvoltage protection (power on/off)	±40 V
ESD protection Arc: Contact:	 8 kV 4 kV
Isolation voltage to the host computer	±500 V
Channel-to-channel isolation	±500 V

Memory Specifications

Table 12 lists the memory specifications for the analog input subsystem on the DT8871U and DT8871 temperature instruments.

Table 12: Memory Specifications

Feature	Specifications
Data memory onboard	4 MByte
For Data logger built in, maximum time before old data is overwritten[a] 48 channels @ 10 Hz: 48 channels @ 1 Hz: 48 channels @ 0.1 Hz:	 30 minutes 5 hours 50 hours

a. Assumes CJC data is not collected AND limit detection is off for all channels. If power fails, all temperature data in the system is lost. The channel input type and filter settings are still available after power on, but the channel and digital I/O labels and channel limits are lost.

A

Temperature Stability Specifications

Table 13 lists the temperature stability specifications for the analog input subsystem on the DT8871U and DT8871 temperature instruments.

Table 13: Temperature Stability Specifications

Feature	Specifications
Additional error due to ambient temperature change[a]	
J-type thermocouple:	0.010° C per degree ambient change, typical
K-type thermocouple:	0.011° C per degree ambient change, typical
B-type thermocouple:	0.014° C per degree ambient change, typical
E-type thermocouple:	0.010° C per degree ambient change, typical
N-type thermocouple:	0.011° C per degree ambient change, typical
R-type thermocouple:	0.012° C per degree ambient change, typical
S-type thermocouple:	0.012° C per degree ambient change, typical
T-type thermocouple:	0.010° C per degree ambient change, typical
Warm-up time	30 minutes
CJC	
Error:	±0.2° C
Accuracy:	Corrected in ROM @ 25° C to zero error
Drift per year:	±50 ppm typical

a. Includes the A/D reference, gain, and CJC errors.

Voltage Measurement Specifications

Table 14 lists the voltage measurement specifications for the analog input subsystem on the DT8871U and DT8871 temperature instruments.

Table 14: Voltage Measurement Specifications

Feature	Specifications
Input voltage range (no compensation) DT8871U: DT8871:	 ±0.0750 V ±1.2500 V
A/D converter resolution	24-bits
Voltage resolution DT8871U: DT8871:	 0.015 µV 0.3 µV
Sample rate	10 Samples/s
Gain	1
Input impedance	5 MΩ typical
Input common mode voltage	±500 V
Common mode rejection @ 60 Hz and 50 Hz	> 150 dB
Coupling	DC
System linearity	±0.005%
System gain error (includes all noise sources; gain = 1)	±0.00075% FSR (1 part in 133,333)
System zero error (includes all noise sources; gain = 1) DT8871U: DT8871:	 0.25 µV RMS (no filter) 5 µV RMS (no filter)
System drift error Zero: Gain:	 ±0.02 µV/° C typical ±4 ppm/° C

Table 14: Voltage Measurement Specifications (cont.)

Feature	Specifications
A/D reference Drift: Drift per year:	 ±8 ppm/° C maximum ±100 ppm typical
Full-scale long-term stability	±100 ppm/year typical zero is auto-zeroed to ±0.25 μV typical for the DT8871U and ±5 μV typical for the DT8871

Digital I/O Specifications

Table 15 lists the specifications for the digital input (DIN) and digital output (DOUT) subsystems on the DT8871U and DT8871 temperature instruments.

Table 15: Digital I/O Specifications

Feature	Specifications
Number of digital I/O lines	16 (8 In, 8 Out)
Number of ports	2, 8-bit (1 In, 1 Out)
Inputs Input type: High input voltage: Low input voltage: High input current: Low input current: Termination	 DC +3 to +28 V < +1.5 V 2.2 kΩ resistor to 1.2 V 2.2 kΩ resistor to 1.2 V Series 2.2 kΩ
Outputs Output type: Output driver: High output: Low output: Breakdown voltage: Contact impedance:	 Solid-state relay CMOS ± 30 V 0.4 V @ 400 mA ± 60 V 1 Ω
Isolation voltage To computer ground: Channel to channel	 ±500 V ±250 V[a]

a. Determined by the pin spacing in the 37-pin digital connector. For greater channel-to-channel isolation, use every other digital I/O line; using every other digital I/O line allows ±500 V isolation channel-to-channel.

Power, Physical, and Environmental Specifications

Table 16 lists the power, physical, and environmental specifications for the DT8871U and DT8871 temperature instruments.

Table 16: Power, Physical, and Environmental Specifications

Feature	Specifications
External power requirements	+5 V ±0.25V @ 1.25 A (0.8 A typical)
Physical	
Dimensions of enclosure:	88.14 (H) x 212.85 mm (W) x 211.43 mm (D)
Weight:	1704 g
Environmental	
Operating temperature range:	0° C to 55° C
Storage temperature range:	–25° C to 85° C
Relative humidity:	to 95%, noncondensing
Altitude:	up to 10,000 feet

Regulatory Specifications

Table 17 lists the regulatory specifications for the DT8871U and DT8871 temperature instruments.

Table 17: Regulatory Specifications

Feature	Specifications
Emissions (EMI)	FCC Part 15, EN55022:1994 + A1:1995 + A2:1997 VCCI, AS/NZS 3548 Class A
Immunity	EN61000-6-1:2001
RoHS (EU Directive 2002/95/EG)	Compliant (as of July 1st, 2006)
Aerospace Material Specification	Compliant with AMS2750D

Thermocouple Connector Specifications

Table 18 lists the thermocouple connector specifications for the DT8871U and DT8871 temperature instruments.

Table 18: Thermocouple Connector Specifications

Feature	Specifications
Thermocouple jacks	Cu-Cu Omega plugs (White SMPW-U-M)
Thermocouple connector	Omega part# PCC-SMP-U-100-R-CE-ROHS

Ethernet (RJ45) Connector Specifications

The Ethernet (RJ45) connector used on the TEMPpoint instruments is shown in Figure 26.

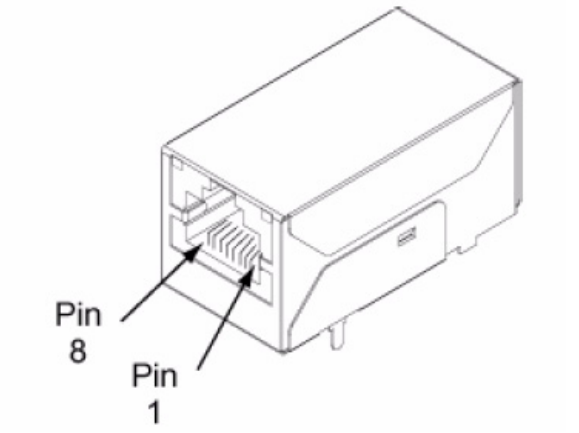


Figure 26: Ethernet (RJ45) Connector

The pin assignments of this connector are described in Table 19:

Table 19: Ethernet Connector Pin Assignments

Pin	Signal Name	Description
1	TXD+	Transmit Data+
2	TXD–	Transmit Data–
3	RXD+	Receive Data+
4	EPWR+	Power from Switch+
5	EPWR+	Power from Switch+

Table 19: Ethernet Connector Pin Assignments (cont.)

Pin	Signal Name	Description
6	RXD–	Receive Data–
7	EPWR–	Power from Switch–
8	EPWR–	Power from Switch–

Note: TEMPpoint instruments do not support Auto-MDIX.

Connector Pin Assignments

Table 20 lists the pin assignments for the 37-pin digital I/O connector on the DT8871U and DT8871 instruments.

Table 20: Digital I/O Connector Pin Assignments

Pin	Description	Pin	Description
1	Digital Input 0+	–	
2	Digital Input 1+	20	Digital Input 0–
3	Digital Input 2+	21	Digital Input 1–
4	Digital Input 3+	22	Digital Input 2–
5	Digital Input 4+	23	Digital Input 3–
6	Digital Input 5+	24	Digital Input 4–
7	Digital Input 6+	25	Digital Input 5–
8	Digital Input 7+	26	Digital Input 6–
9	Not Connected	27	Digital Input 7–
10	Digital Output 0	28	Not Connected
11	Digital Output 1	29	Digital Output 0
12	Digital Output 2	30	Digital Output 1
13	Digital Output 3	31	Digital Output 2
14	Digital Output 4	32	Digital Output 3
15	Digital Output 5	33	Digital Output 4
16	Digital Output 6	34	Digital Output 5
17	Digital Output 7	35	Digital Output 6
18	Not Connected	36	Digital Output 7
19	Not Connected	37	Not Connected

Using the TEMPpoint Application

Overview

In addition to the web interface, described in Chapter 5, you can verify the operation of the DT8871U and DT8871 temperature instruments using the TEMPpoint application that is provided with the instrument. The TEMPpoint application, developed using Measure Foundry, lets you perform the following functions:

- Configure your TEMPpoint instrument
- Acquire temperature or voltage data from up to 48 analog input channels
- Display temperature or voltage data during acquisition
- Use a Chart Recorder to display and log data to an.hpf file for later analysis
- View any .hpf file, and view the last recorded .hpf data file in Microsoft Excel®
- Set minimum and maximum alarm limits for each channel
- Set the state of the digital output lines based on alarm limits
- Read the state of the digital input port

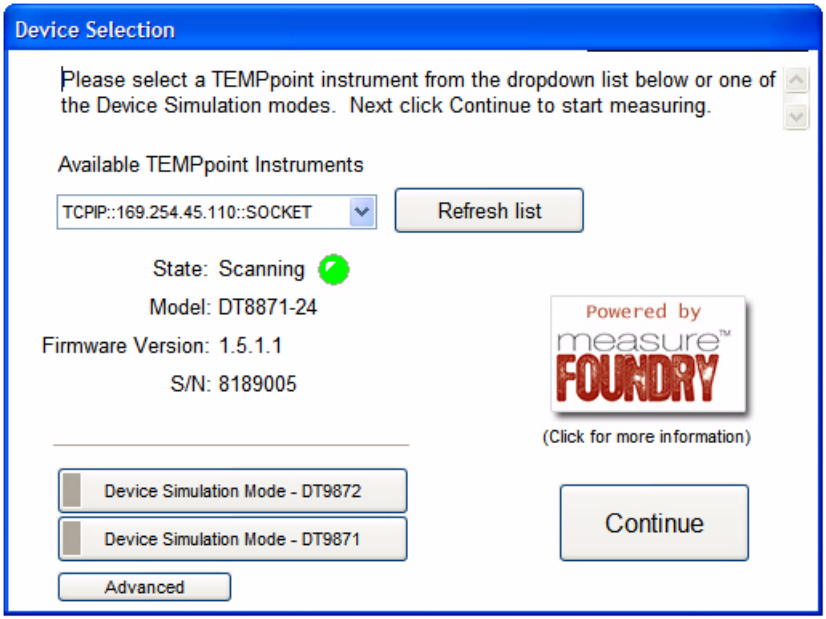
If desired, you can use Measure Foundry to customize this application.

Refer to page 31 for information on installing the TEMPpoint application.

Running the TEMPpoint Application

To run the TEMPpoint application, perform the following steps:

1. Click **Start** -> **Programs** -> **Data Translation, Inc** -> **TEMPpoint** -> **TEMPpoint**
   The Device Selection screen is displayed:



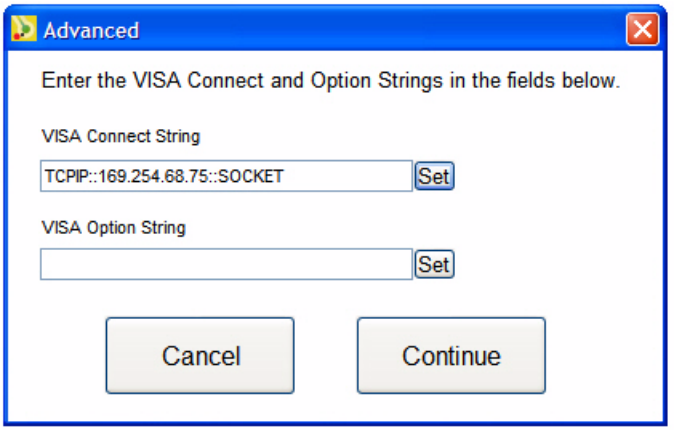
2. By default, the application "discovers" all of the TEMPpoint instruments that are available and displays them in the list of Available TEMPpoint Instruments. If you want to refresh this list to determine if other TEMPpoint instruments are available, click **Refresh list**.

3. If you do not have a TEMPpoint instrument connected or if you want to simulate the operation of a device, click **Device Simulation Mode - DT9871** to simulate the operation of the DT9871 or click **Device Simulation Mode - DT9872** to simulate the operation of the DT9872, and go to step 6.
   When selected, the button indicator turns green.

4. If your TEMPpoint instrument is included in the list of Available TEMPpoint Instruments and you want to connect to it, select the connect string for the TEMPpoint instrument that you want to use from the list of Available TEMPpoint Instruments and go to step 6.
   Information about the instrument, including the scanning status, model number, firmware version, and serial number, is displayed.

5. If your TEMPpoint instrument is not included in the list of Available TEMPpoint instruments, but you want to manually connect to it, do the following:

   a. Click **Advanced**.
      The following screen is displayed:



b. Determine the IP address of your instrument on the TCP/IP network using an LXI discovery tool, such as the Eureka Discovery Utility provided with your TEMPpoint instrument, see page 75 for information on using this utility.

c. Enter the VISA Connect String for your device (such as TCPIP::192.43.218.69::INSTR or TCPIP::192.43.218.44::SOCKET), and click **Set**.

d. If you want to simulate the operation of a device, enter the string **simulate=true,model=DTxxxx** in the VISA Option String text box and click **Set,** where *xxxx* equals **9871** for a DT9871, **9872** for a DT8872, **8871** for a DT8871, or **8872** for a DT8872 instrument.

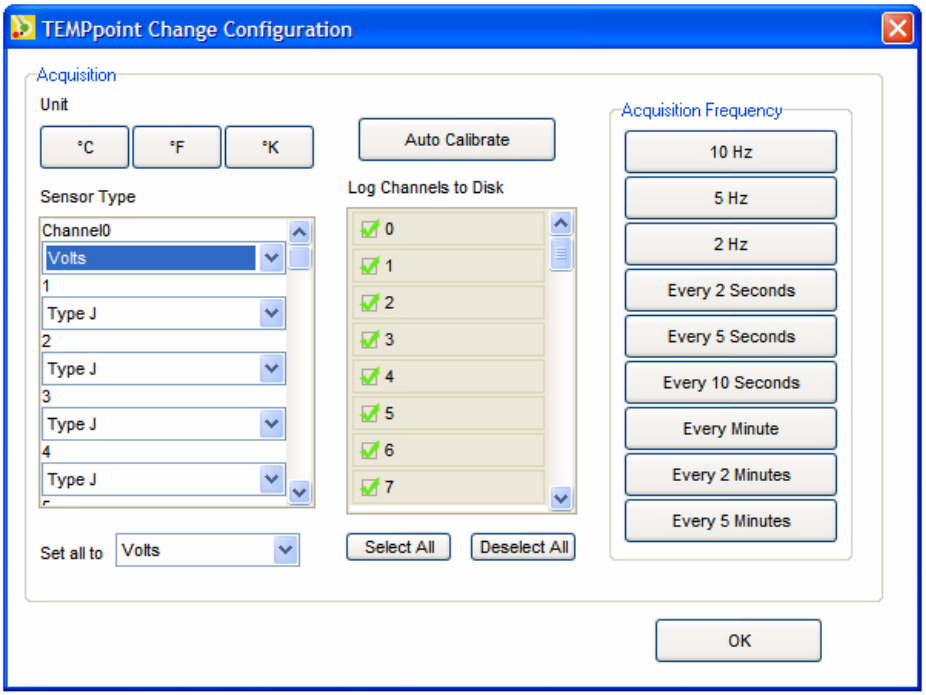
6. Click **Continue**.
The latest state is saved and used when the application is next run, and the Channel Overview screen of the TEMPpoint application is displayed. Note that data acquisition is started automatically and temperature values are displayed (in degrees C), by default.

Figure 27: Channel Overview Screen of the TEMPpoint Application

Changing the Configuration of Your TEMPpoint Instrument

To change the configuration of your TEMPpoint instrument, follow these steps:

1. Stop acquisition by clicking **Stop Acquisition** from the **Acquisition** menu or by clicking **Start/Stop** from the main window.
2. Click the **Configuration** menu, and then click **Change Configuration**.
   The Change Configuration screen is displayed:



3. Under **Unit**, select the temperature units in which to display temperature data: °C (Celsius), °F (Fahrenheit), or °K (Kelvin).
4. Under **Sensor Type**, select the input type (Volts, J, K, B, E, N, R, S, or T) for each of the channels.

Notes: If you want to set all the channels to the same configuration at once, select the configuration to apply using the **Set all to** combo box.

If you select a sensor type of Volts for a channel, the data is displayed in voltage. The sensor type setting is ignored for the digital input port.

---

5. Under **Log Channels to Disk**, check the channels that you want to log to disk when you use the Chart Recorder (described on page 160). The first time you use the TEMPpoint application, all channels are selected for data logging.
6. Under **Acquisition Frequency**, click the frequency (10 Hz, 5 Hz, 2 Hz, Every 2 s, Every 5 s, Every 10 s, Every Minute, Every 2 Minutes, Every 5 Minutes) at which to simultaneously sample all channels.

Notes: If you wish to calibrate all channels (performing an auto-zero function on software command), click the **Auto Calibrate** button.

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7. When you are finished configuring the TEMPpoint application, click **OK**.
8. To save the configuration settings, click the **Configuration** menu, and then click **Save Configuration File**.

9. Enter a name for the configuration file, select the directory in which to save the file, and then click **Save**.
This file, which has the extension .TEMPpoint, is saved in the following directory on your hard disk, by default: \Documents and Settings\All Users\Application Data\Measure Foundry\Examples\ Ready-to-Measure Applications.

Note: You can save numerous configuration settings, if desired. To load a previously saved configuration, click the **Configuration** menu, and then click **Load Configuration File**.

---

10. Restart acquisition by clicking **Start Acquisition** from the **Acquisition** menu or by clicking **Start/Stop** from the main window.

Defining Alarm Limits

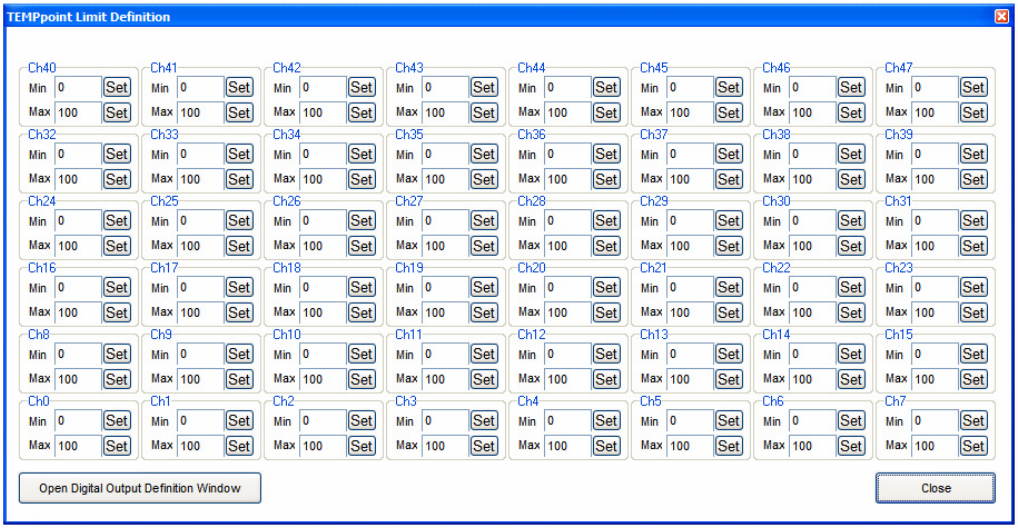
When you start the TEMPpoint application for the first time, the following alarm limits are defined for each channel:

- Minimum alarm limit = 0
- Maximum alarm limit = 100

If the acquired value for a channel is between the defined minimum and maximum alarm limits, the value is within range and is displayed in black. If the acquired value for a channel is below the minimum or above the maximum alarm limit, the value is out of range and is displayed in red.

To change the alarm limits, do the following:

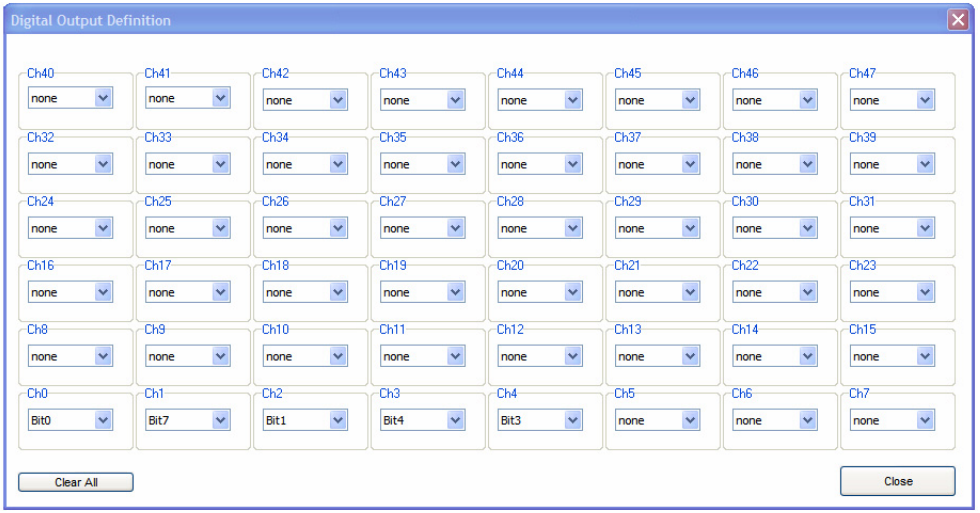
1. Select the **Windows** menu, and then select **Limit Definition**.
   A screen similar to the following is displayed:



2. If you want to change the minimum alarm limit for a channel, enter a value in the **Min** field for that channel, and then click **Set** next to the value that you entered.

3. If you want to change the maximum alarm limit for a channel, enter a value in the **Max** field for that channel, and then click **Set** next to the value that you entered.

4. If you want to set a digital output line when the alarm limits for a channel are exceeded, click the **Open Digital Output Definition Window** button from the **Limit Definition** screen.
The following screen appears:



5. For each channel, select the digital output line (bit) that you want to turn on when the limits for a channel are exceeded. If you do not want to set a digital output line when the alarm limits are exceeded, choose **none**.

Note: You can assign the same digital output line to multiple channels. The digital output line is turned on (1) when any of the alarm limits are exceeded on the channels that were assigned to that digital output line.

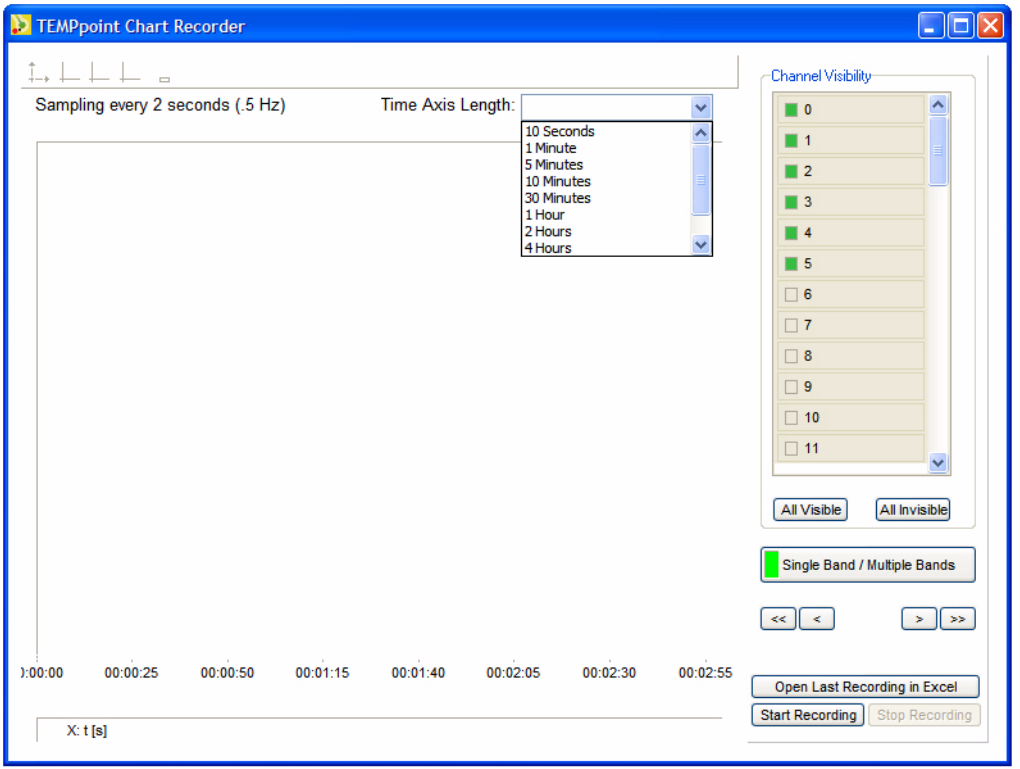
If alarm limits are not exceeded, the digital output line is turned off (0).

6. To see the state of the digital output lines, click the **OUT** button from the upper-left of your screen, or select the **Windows** menu and then select **Digital Output Panel**.
A screen similar to the following appears:

Logging Data to Disk

To log data to disk, perform the following steps:

1. Ensure that you configured the channels that you want to log to disk (see page 155).
2. Start acquisition by clicking **Start Acquisition** from the **Acquisition** menu or by clicking **Start/Stop** from the main window.
3. Click the **CRT** button from the upper-left of your screen, or from the **Windows** menu, select **Chart Recorder**.
   A screen similar to the following appears:



4. Under **Channel Visibility**, select the channels that you want to be visible on the display.

Note: The first time that you run the TEMPpoint application, all the channels are visible.

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5. From the **Time Axis Length** drop-down list, select the time (10 Seconds, 1 Minute, 5 Minutes, 10 Minutes, 30 Minutes, 1 Hour, 2 Hours, 4 Hours) to use for the time axis.
6. If you want to display all the data on a single band, leave the **Single Band/Multiple Band** button untouched (the button indicator is green).

   If you want to display the data for each channel on a separate band, click the **Single Band/Multiple Band** button so that the button indicator turns gray.
7. To begin recording data, click the **Start Recording** button.
   You are prompted to name the file in which to store the recorded data.

Note: The data file has an .hpf extension and is saved in the following directory on your hard disk: \Documents and Settings\All Users\Application Data\Measure Foundry\Examples\ Ready-to-Measure Applications

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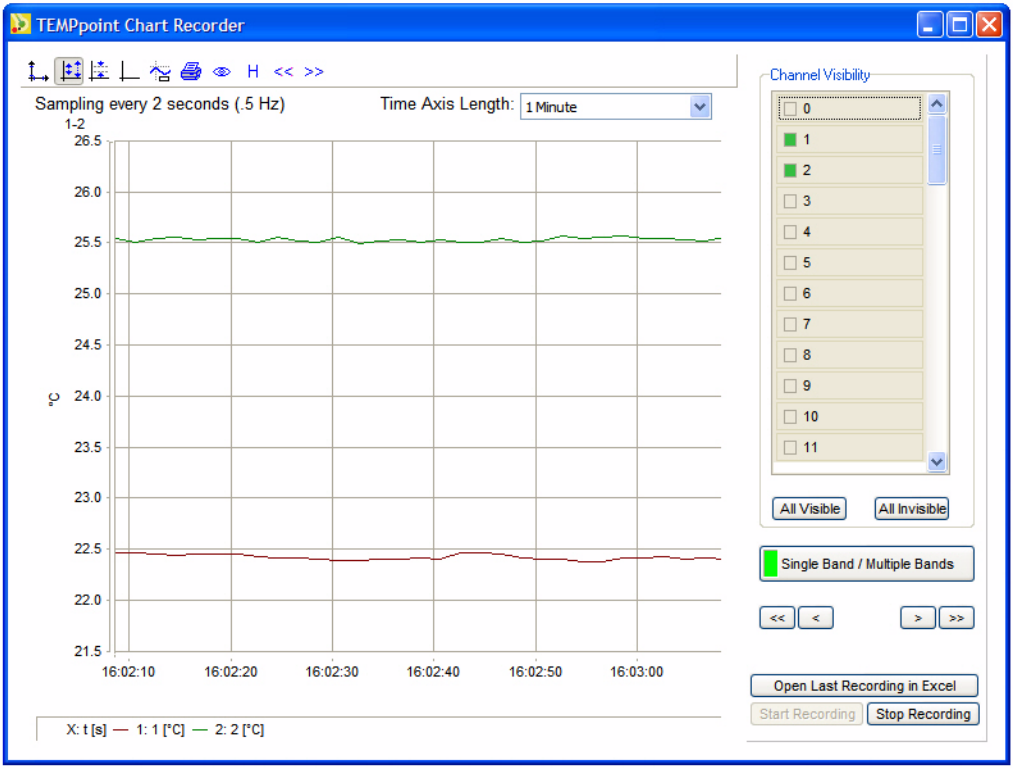
8. Enter a name for the data file, and then click **Save**.
   The data for each channel is then displayed on the screen and logged to disk:



9. When you have finished recording, click the **Stop Recording** button.

10. If you want to view this data in Microsoft Excel, click the button called **Open Last Recording in Excel**.

Note: The Chart Recorder has other features, such as scrolling, autoscaling, printing, and so on. Refer to the online help provided with the TEMPpoint application for more information on these features.

Viewing a Data File

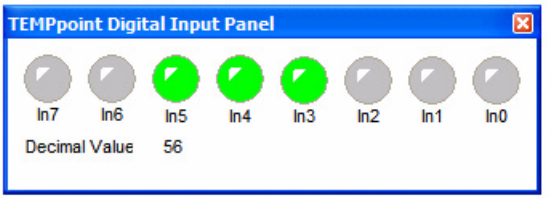
To view the data that you recorded in an .hpf file with the Chart Recorder, perform the following steps:

1. (Optional) From the Windows menu, select **File Viewer**.
2. From the **File** menu, select **Load Data File**.
   You are prompted to select the name of the data file to view.
3. Select the name of the data file to view, and then click **Open**.
   The data file is displayed in the File Viewer window.
4. You can then scroll through the data, change the scale of the display, print the data, and so on. Refer to the online help provided with the TEMPpoint application for more information about these features.
5. When you are finished viewing the data file, click **Close.**

Reading Digital Input Values

To read the state of the digital input port, perform the following steps:

1. Click the **IN** button from the upper-left of your screen, or from the **Windows** menu, select **Digital Output Panel**.
   A screen similar to the following appears:



Note: The LED indicator turns green when a value of 1 is detected on the digital input line and turns gray when a value of 0 is detected on the digital input line.

Exiting from the TEMPpoint Application

When you finished using the TEMPpoint application, exit from the application by selecting the **File** menu and clicking **Quit**.

Configuring Network Settings on Your PC

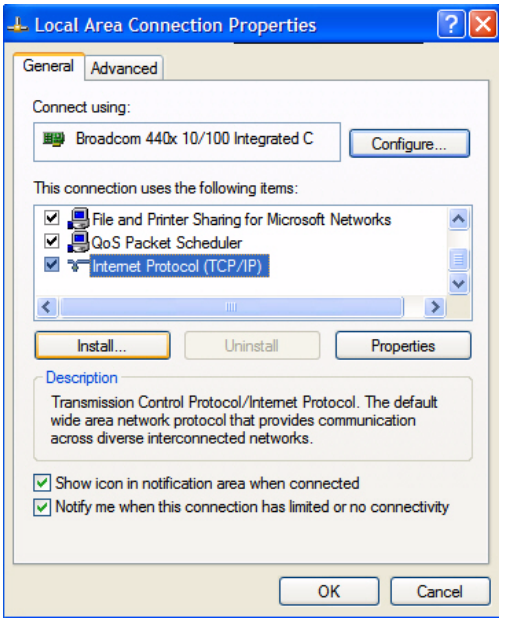
Configuring the PC to Use Auto-IP

To set up the TEMPpoint instrument when the LAN does not support a DHCP server and your PC is configured to use a static IP address, you must temporarily reconfigure the PC to use Auto-IP by performing the following steps:

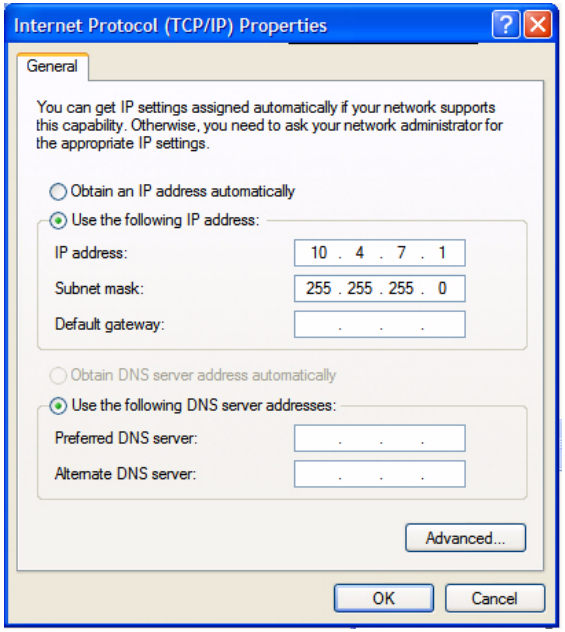
Note: This procedure may differ slightly depending on your computer and the version of Windows you are using. Windows XP instructions are shown here.

---

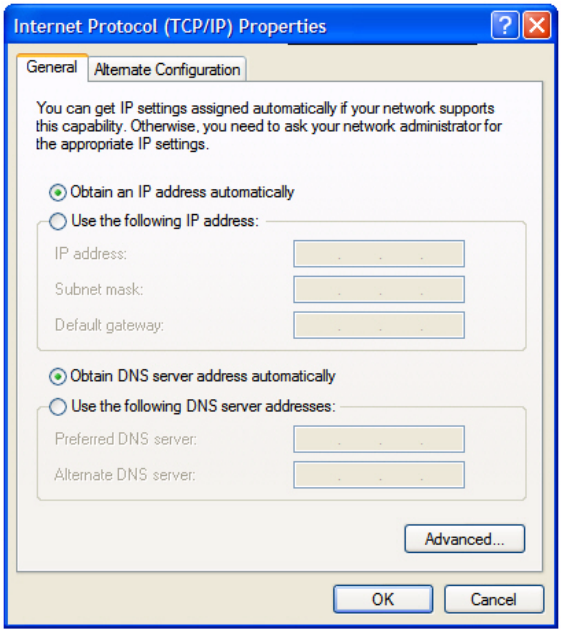
1. From the Windows Start menu, click **Settings**, and then click **Network Connections**.
2. Right-click **Local Area Connection**, and select **Properties.**



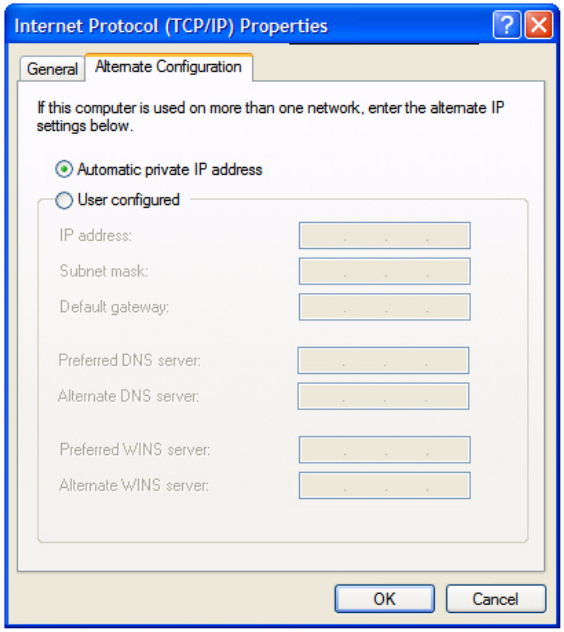
3. In the General tab window, double-click **Internet protocol (TCP/IP)**.
   (If a TCP/IP selection is not listed, click **Install**, select **Protocol**, click **Add**, select the TCP/IP protocol, and click **Install**, and repeat step 3).



4. **IMPORTANT: Write down the IP address and subnet mask that is displayed!** You will need this information later.
5. Select **Obtain an IP address automatically**, and then click **OK**.



6. Select the **Alternate Configuration** tab, and ensure that **Automatic private IP address** is selected.



7. Renew the IP address of the computer. From the Windows Start menu, click **Settings** ->**Network Connections** -> **Local Area Connection** -> **Support** -> **Repair**.

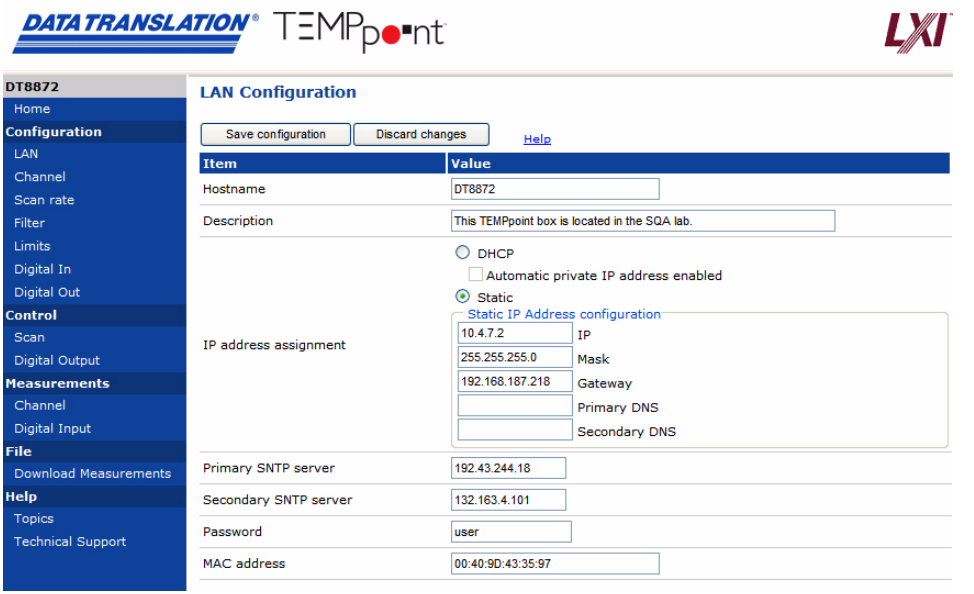
   Or, if you prefer to do this from the command prompt window, click **Run** from the Windows Start menu, enter **cmd**, and click **OK** to bring up the command prompt window. Then, from the command prompt window, enter:

   `ipconfig /renew` *renews the IP address*
   `ipconfig /all` *checks the IP address*

Specifying a Static IP Address for your Instrument

To specify a static IP address for your TEMPpoint instrument, use the LAN Configuration page of the web interface as follows:

1. From the LAN Configuration page, click **Modify**.
2. Specify the username as **sysadmin**, and specify the password (the default password is **user**). You can change the password, if you desire.
3. Uncheck the checkbox called **Automatic private IP address enabled**.
4. Click **Static**.
5. Specify a static IP address for the TEMPpoint instrument, so that is will be on the same subnet as your PC:

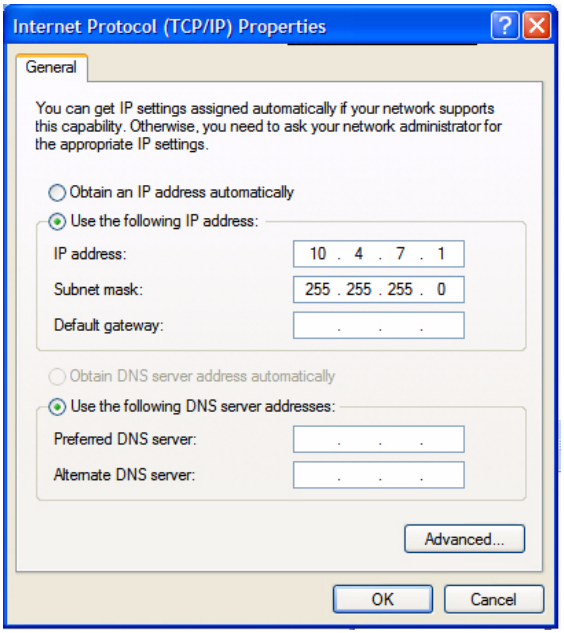


Note: You need a Simple Network Time Protocol (SNTP) time server on the LAN; otherwise, you need to provide a gateway. See your network administrator for more details.

Reconfiguring the PC to Use a Static IP Address

After you have set up your TEMPpoint instrument, you can reconfigure your PC to use a static IP address using this procedure:

1. From the Windows Start menu, click **Settings**, and then click **Network Connections**.
2. Right-click **Local Area Connection**, and select **Properties.**
3. In the General tab window, double-click **Internet protocol (TCP/IP)**.
4. Select **Use the following IP address:**, specify the static IP address and subnet mask that was initially assigned to the PC (see page 168), and click **OK**.



5. Renew the IP address of the computer. From the Windows Start menu, click **Settings** ->**Network Connections** -> **Local Area Connection** -> **Support** -> **Repair**.

Or, if you prefer to do this from the command prompt window, click **Run** from the Windows Start menu, enter **cmd**, and click **OK** to bring up the command prompt window. Then, from the command prompt window, enter:

`ipconfig /renew`	*renews the IP address*
`ipconfig /all`	*checks the IP address*

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